U.S. Department of Transportation

REPORT TO CONGRESS AIRLINE CABIN AIR QUALITY

Washington, D.C. 20590

February 1987

Report of the U.S. Department of Transportation to the United States Congress pursuant to Public Law 98-466

NOTICE

Copies of this report are available on written request to the U.S. Department of Transportation, Utilization and Storage Section, M-443.2, 400 7th Street, SW., Washington, DC 20590.

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US Department
of Transportation

**Federal Aviation
Administration**

Office of the Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

FEB 27 1987

The Honorable George Bush
President of the Senate
Washington, DC 20510

Dear Mr. President:

I am pleased to submit "The Airliner Cabin Environment--Air Quality and Safety" report prepared in response to Public Law 98-466, dated October 11, 1984. The Department of Transportation (DOT) was directed to commission the National Academy of Sciences (NAS) to conduct an independent study on the cabin air quality in airliners and to submit the study to Congress, along with any comments and recommendations for legislative, regulatory, or industry changes.

The NAS study, which focuses on all health and safety aspects of airline cabin air quality, covers five general subjects: cabin air quality, cabin environment, emergency procedures, regulations, and records. It summarizes the findings of the NAS Committee on Airliner Cabin Air Quality and outlines 21 recommendations for consideration by DOT.

The Department has now completed its review of the NAS recommendations. An Executive Summary and a Summary of Recommendations and Conclusions are contained in the enclosed "Airline Cabin Air Quality" report.

I have sent an identical letter to the Speaker of the House of Representatives.

Sincerely,

Donald D. Engen

Donald D. Engen
Administrator

2 Enclosures

US Department
of Transportation

**Federal Aviation
Administration**

Office of the Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

FEB 27 1987

Dr. Frank Press
President
National Academy of Sciences
2101 Constitution Avenue, NW.
Washington, DC 20418

Dear Dr. Press:

The Department of Transportation (DOT) has completed its review of "The Airliner Cabin Environment--Air Quality and Safety" report prepared by the National Academy of Sciences (NAS) in response to Public Law 98-466.

The enclosed report, "Airline Cabin Air Quality," provides DOT's response to the 21 recommendations of the Committee on Airliner Cabin Air Quality (the Committee). DOT has accepted in full or in part most of the recommendations of the Committee.

Although research is still needed in the area of cabin air quality, the NAS study has laid the necessary groundwork. Please convey my appreciation to the members of the Committee.

I have also sent copies of both reports to the Speaker of the House of Representatives and the President of the Senate.

Sincerely,

Donald D. Engen

Donald D. Engen
Administrator

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EXECUTIVE SUMMARY

Public Law (P.L.) 98-466, dated October 11, 1984, directed the Secretary of Transportation to commission an independent study by the National Academy of Sciences (NAS) on the cabin air quality in airliners and to submit a copy of that study, together with any comments and recommendations to Congress.

In compliance with P.L. 98-466, a contract was negotiated between the Federal Aviation Administration (FAA) and the NAS. The NAS formed the Committee on Airliner Cabin Air Quality (the Committee) to study all safety aspects of airline cabin air quality and submitted its report, "The Airliner Cabin Environment--Air Quality and Safety," to the FAA on August 12, 1986. The NAS study focuses on all health and safety aspects of airline cabin air quality. The report includes recommendations for legislative, regulatory, and industry changes in relation to airline cabin air quality. The Executive Summary of the NAS report contains the Committee's findings and recommendations.

This report provides the Department of Transportation's (DOT) response to the 21 recommendations made by the Committee. We have accepted in full or in part most of the recommendations of the Committee. Three major issues of special interest--a proposed ban on smoking, further study of cabin air quality, and Federal responsibility for health effects associated with air travel--are addressed below:

1. Proposed Ban on Smoking

   The Committee recommended a ban on smoking on all commercial domestic flights.

   While DOT recognizes that exposure to environmental tobacco smoke (ETS) could be viewed as a problem by some crew and passengers, we believe that further study is needed before the Department can propose a definitive response to this recommendation.

   Issues that require further consideration include the following:

   - Further review of the health effects of ETS, including review of the studies and reports completed since the NAS study.

   - Further review of the concentration and distribution of pollutants for various aircraft types.

   - Additional consideration of possible technological solutions (which the Committee found infeasible) to determine if modifications to aircraft ventilation systems or procedures would provide acceptable results.

   - Further consideration of possible application of any proposed solutions to international, as well as domestic, flights.

2. Study of Cabin Air Quality

A major finding of the Committee was "...that, if the lowest rate of ventilation permitted by current equipment design were used under conditions of full or nearly full passenger loads, the resulting ventilation rate would be at the minimum determined to provide acceptable air quality when smoking is not permitted and other contaminant sources are not present. In the absence of sources of contamination, this rate does not constitute a health hazard."

Based on this finding, the Committee recommended that "A data collection program that measures airflow and contamination in airplanes should be implemented."

DOT concurs with the Committee's finding. Discussions, which began in May 1984, will be renewed with the Environmental Protection Agency. A cooperative effort will be made to determine the feasibility of initiating a practical program for making cabin air quality measurements on board airplanes during typical operations. Contaminants from all sources will be considered as a major item in the conception of this program.

3. Federal Responsibility for Air Travel Health Effects

The finding of the Committee that no Federal agency has direct responsibility for dealing with health effects associated with air travel was based on misinformation. In fact, the Department does have authority through FAA and the Office of the Secretary covering both crew and passenger health. The FAA has the authority to regulate the health aspects of an aircraft in operation. In addition, the Office of the Secretary is required by law to ensure that airlines provide "safe and adequate service." Other Federal agencies have complementary health responsibilities. The responsibilities of these agencies do not conflict with those of DOT.

Given the broad range of DOT authority over passenger and crew health, as well as the expertise and the nature of the missions of the other agencies which have health responsibilities, we see no reason to consolidate or transfer any authority. We recommend retention of the present system of health responsibilities.

SUMMARY OF RECOMMENDATIONS/CONCLUSIONS

The following is a summary of the recommendations made by the Committee followed by DOT's conclusions/recommendations to Congress (in bold type). Section II of this report contains a detailed commentary of the reasons for DOT's recommendations and conclusions. For reference purposes, the page number corresponding to each recommendation contained in Section II is included at the end of each DOT recommendation.

1. "The Committee believes that the health effects associated with air travel should be within the purview of a Federal agency."

   The finding of the Committee that no Federal agency has direct responsibility for dealing with health effects associated with air travel was based on misinformation. In fact, the Department does have authority through FAA and the Office of the Secretary covering both crew and passenger health. Other Federal agencies have complementary health responsibilities. The responsibilities of these agencies do not conflict with those of DOT.

   Given the broad range of DOT authority over passenger and crew health, as well as the expertise and the nature of the missions of the other agencies which have health responsibilities, we see no reason to consolidate or transfer any authority. We recommend retention of the present system of health responsibilities.

   (Reference Page 3)

2. "The Committee found that, if the lowest rate of ventilation permitted by current equipment design were used under conditions of full or nearly full passenger loads, the resulting ventilation rate would be at the minimum determined to provide acceptable air quality when smoking is not permitted and other contaminant sources are not present. In the absence of sources of contamination, this rate does not constitute a health hazard."

   This was a finding of the Committee and requires no action.

   (Reference Page 5)

3. "A data collection program that measures airflow and contamination in airplane cabins should be implemented."

   Discussions, which began in May 1984, will be renewed with the Environmental Protection Agency. A cooperative effort will be made to determine the feasibility of initiating a practical program for making cabin air

quality measurements on board airplanes during typical operations. Contaminants from all sources will be considered as a major item in the conception of this program. Another topic that will be included in these discussions is whether the many variables of flight can be monitored or controlled to correlate test results from different flight conditions.

(Reference Page 6)

4. "The FAA standard (on carbon dioxide) is much higher than standards for other confined environments. The Committee recommends that the FAA review its carbon dioxide standard."

The FAA will review the need to establish either ventilation limits, reduced carbon dioxide limits, or both. After the review, any needed rule change and advisory material will be proposed.

(Reference Page 7)

5. "Therefore, the Committee suggests that FAA carry out a carefully designed program to ensure that cabin ozone concentrations comply with Department of Transportation regulations."

The FAA will issue biennial action notices requiring FAA inspectors to report on the present status of all U.S. air carriers' compliance with the existing ozone regulations. The responses to the action notices will be summarized and published. Identified deficiencies will be corrected.

(Reference Page 8)

6. "The Committee recommends a ban on smoking on all domestic commercial flights, for four major reasons: to lessen irritation and discomfort to passengers and crew, to reduce potential health hazards to cabin crew associated with ETS (environmental tobacco smoke), to eliminate the possibility of fires caused by cigarettes, and to bring the cabin air quality into line with established standards for other closed environments."

The Committee stated that "Empirical evidence is lacking in quality and quantity for a scientific evaluation of the quality of airliner cabin air or of the probable health effects of short or long exposure to it."

We agree that exposure to ETS could be viewed as a problem by some crew and passengers. However, we believe that further study is needed before the Department can propose a definitive response to this recommendation.

Issues that require further consideration include the following:

- Further review of the health effects of ETS, including review of the studies and reports completed since the NAS study.

- Further review of the concentration and distribution of pollutants for various aircraft types.

- The effectiveness and economic effects of possible technological solutions such as modifications to aircraft ventilation systems or procedures.

- Further consideration of possible application of any proposed solutions to international, as well as domestic flights.

(Reference Page 10)

7. "Because a likelihood of occurrence of epidemic disease when forced-air ventilation is not available on the ground has been demonstrated, the Committee recommends that a regulation be established that requires removal of passengers from an airplane within 30 minutes or less after a ventilation failure or shutdown on the ground and maintenance of full ventilation whenever onboard or ground air-conditioning is available."

Because the occurrence of complete ventilation cessation on passenger-laden airplanes is extremely rare and sometimes unavoidable, we do not believe that regulatory action is necessary. However, there may be value in bringing this concern to the attention of the air carriers. The FAA will advise air carriers of the need to deplane passengers, if possible, after 30 minutes without ventilation.

(Reference Page 12)

8. "The Committee also recommends that maximal airflow be used with full passenger complements to decrease the potential for microbial exposure and that recirculated air be filtered (to remove particles larger than 2-3 um) to reduce microbial aerosol concentrations."

The program for making cabin air quality measurements identified under Recommendation 19 will include microbial aerosol concentrations at different cabin airflows. Whether or not maximal airflow is required at all times will be evaluated at the conclusion of this measurement program.

(Reference Page 13)

9. "The Committee concluded that current pressurization criteria and regulations are generally adequate to protect the traveling public. However, the medical profession should use a more efficient system to warn those with existing medical conditions who are more susceptible to changes in pressure or to long exposure to low pressure that there might be some hazard to their health."

The FAA will continue its ongoing effort to provide aviation medical information to the members of the medical profession to enhance their ability to advise those patients at risk concerning possible hazards secondary to the in-flight environment. In addition to direct contact with FAA-designated aviation medical examiners, the FAA will continue to encourage publication of such information in medical journals. The American Medical Association will be asked to republish the excellent article "Medical Aspects of Transportation Aboard Commercial Aircraft" (Journal of the American Medical Association, February 19, 1982, Volume 247, Number 7) (Appendix 3).

(Reference Page 14)

10. "FAA should consider rule-making that restricts exposure [to cosmic radiation] of pregnant flight crew and crew members. In addition, FAA should investigate total radiation exposure of flight crew and cabin crew members through the use of a statistical sample of full-time employees and should require airlines to provide precautionary information to their flight attendants about radiation exposure."

The FAA is currently developing advisory information to promote radiation safety through educational initiatives for use by the air carrier industry. This information will be distributed, and with management cooperation, crewmembers concerned with radiation exposure will be able to limit such by scheduling within domestic and flag route systems.

(Reference Page 15)

11. "The Committee approves of current efforts to base passenger safety briefings and written materials on empirical testing of comprehension and retention."

This recommendation does not require DOT action.

(Reference Page 16)

12. "The Committee suggests that FAA or appropriate industry organizations consider the advisability of developing an empirical research program to examine passenger response to safety instructions under routine and emergency conditions and revise them as appropriate. Consideration should be given to running some quizzes during a flight to see, for example, what proportion of passengers have retained the key features of the safety briefing."

Attentive passengers who have received the preflight briefings could "pass" quizzes given during nonstressful flight situations, however, that does not necessarily mean that they will take the correct action in a given emergency situation.

The FAA is deeply interested in suggested improvements for briefing techniques from the the airline industry but believes that requiring a quiz data base is not appropriate.

The guidance concerning these briefings is contained in AC 121-24. This AC will be updated as necessary.

(Reference Page 16)

13. "The Committee recommends that FAA require that information on proper response to fire emergencies be included in oral and written passenger safety information."

Recent occurrences of unwarranted passenger-initiated emergency evacuations have caused concern that preflight briefings may in some cases motivate some people to act independently and unnecessarily. The accepted practice of both the FAA and the airline industry is that briefings concerning emergency actions should not create passenger apprehension or inspire unwarranted actions by passengers. The emergency procedures for passengers are, therefore, relatively passive (i.e., follow instructions given for their individual protection) while trained crewmembers implement procedures and deploy any required equipment necessary to assure the continued safe flight and landing of the airplane and the safety of the passengers. The FAA will continue the present practice.

(Reference Page 17)

14. "The Committee feels that continuing research (fire safety) is also needed in materials development."

The FAA agrees that continuing research is needed in the development of improved fire-safe materials. The FAA's part in this research generally entails the analysis of fire-safety problems and the development and validation of practical small-scale test equipment that can be used to measure reliably the relative fire-safety characteristics of materials. Using this test equipment, the FAA cooperates with material producers, interior fabricators, aircraft manufacturers, and airlines in the development and adaptation of new materials which have a high level of fire safety as well as durability, cleanability, appearance, and other practical characteristics necessary for economically competitive materials.

Recent examples of this highly-successful, cooperative approach between FAA and industry include the establishment of new standards for heat-resistant evacuation slide materials, cargo compartment fire barrier liner materials, fire-safe seat cushion materials, and cabin wall and ceiling panel materials.

The FAA plans to continue this approach in the development of improved materials and believes that this action is responsive to the Committee's recommendation.

(Reference Page 18)

15. "The Committee noted that current emergency procedures for smoke removal recommend that the cabin be depressurized to 10,000 ft. This procedure is ineffective and should be discontinued."

The FAA will obtain and review additional information that is known to address the smoke evacuation issue. This will include a Lockheed study that investigated decompression as a means to control or extinguish a fire, pertinent information retained by the cognizant aircraft certification offices, and any additional information from the NAS. NTSB in-flight smoke and fire accident/incident reports will also be reviewed. Based on this review, the FAA will determine the effectiveness of the current emergency procedures for smoke removal.

AC 25-9 will be revised to be more specific relative to decompression procedures and include any limitations on their use.

(Reference Page 19)

16. "However, there are generally more crew members than fire extinguishers, and the Committee recommends that FAA review the proposed rule on protective breathing devices for crew members to ascertain the desirability of supplying such equipment for all crew members, rather than limiting it to the persons expected to be involved in firefighting. In addition, the Committee suggests further evaluation of the potential of emergency breathing equipment for all cabin crew members to improve safe and expeditious evacuation of passengers in fire emergencies."

The evaluation of the potential of emergency breathing equipment for all cabin crewmembers to improve the safe and expeditious evacuation of passengers in fire emergencies will be conducted in conjunction with the planned action on Recommendation Number 17.

The FAA is currently participating in a joint international effort between representatives of the Civil Airworthiness Authorities of Canada, France, and the United Kingdom. A meeting will be held in May 1987 between the four nations to decide on further activity. Once this international effort is completed, the FAA will assess the need for regulatory action.

(Reference Page 20)

17. "The Committee recommends that FAA re-examine passenger protective breathing devices and consider requiring that such equipment be available in case of in-flight and postcrash fires."

A joint international effort between representatives of the Civil Airworthiness Authorities of the United States (FAA), Canada, France, and the United Kingdom on passenger protective breathing equipment will continue.

Several meetings have been held during the last 6 months. The groups' objective is to perform a worldwide accident and incident analysis to fully summarize fire events and human factors, in order to evaluate the safety potential of individual passenger protective breathing devices under different fire scenarios. The group will also begin development procedures for testing the devices.

A meeting will be held in May 1987 between the four nations to decide on further activity. Once this international effort is completed, the FAA will assess the need for regulatory action.

(Reference Page 21)

18. "The Committee was charged with performing a comparison of foreign industry practices, regulations, and standards, and has gathered relevant information applicable to the issues addressed in this study. Although some differences from those in the United States have been noted, they do not appear to be significant. The Committee feels that greater effort along these lines is not warranted."

This recommendation does not require DOT action.

(Reference Page 22)

19. "The Committee therefore recommends that FAA establish a program for the systematic measurement, by unbiased independent groups, of the concentrations of carbon monoxide, respirable suspended particles, microbial aerosols, and ozone and the measurement of actual ventilation rates, cabin pressures, and cosmic radiation on a representative sample of routine commercial flights. These findings should be subjected to peer review."

Discussions, which began in May 1984, with the Environmental Protection Agency will be renewed regarding the advisability and feasibility of initiating a practical program for making cabin air quality measurements on board airplanes during typical operations.

(Reference Page 23)

20. "The Committee recommends that FAA establish a program to monitor selected health effects on airliner crews."

The FAA will continue its efforts to ensure the occupational health and safety of crewmembers in response to established needs. The FAA will discuss with the National Institute of Occupational Safety and Health the feasibility of establishing a program to monitor selected health effects on airline crews.

(Reference Page 25)

21. "The Committee recommends that FAA collect these data (uses of recently mandated medical kits) in such a way as to permit comparison of onboard incidents with those in other settings."

The rule in 14 CFR 121.715, effective August 1, 1986, requires each certificate holder to maintain records on each medical emergency occurring during flight time resulting in the use of the emergency medical equipment, diversion of the aircraft, or death of a passenger or crewmember over a period of 24 months. This existing data collection program is fully responsive to the NAS recommendation.

This information will be used to determine future need for the carriage of emergency medical equipment on air carrier aircraft. This data will also be available for use in studies comparing medical incidents on board air carrier aircraft with those in other settings. The FAA will not undertake these comparative studies since it does not have the authority. Such studies would be inappropriate for the FAA.

(Reference Page 26)

SECTION I.

INTRODUCTION

This report provides the Department of Transportation's (DOT) response to the recommendations made by the National Academy of Sciences (NAS) in its report, "The Airliner Cabin Environment--Air Quality and Safety," dated August 13, 1986.

Public Law (P.L.) 98-466, dated October 11, 1984, directed the Secretary of of Transportation to commission an independent study by the NAS on the cabin air quality in airliners and to submit a copy of that study, with any comments and recommendations to Congress.

Since this was to be an independent study, the Federal Aviation Administration (FAA) did not participate or take any action that could affect the findings, conclusions, or recommendations of the study. At the request of the NAS, however, the FAA provided data and assistance during the course of the study.

Each of the NAS recommendations has been assigned a number to correspond with the sequence in which they are enumerated in the Executive Summary of the NAS report. The DOT report is formatted so that each NAS recommendation is quoted, followed by subsections labeled Comments and Planned Action.

A chronology of the events leading to this report follows:

o May 1980	Xenex Corporation (Hawaii) petitioned to add requirements for a specified amount of fresh air in cabin, humidification, and air contamination.
o May 1981	Petition denied.
o October 1981	S.1770 introduced by Senator Inouye (Hawaii) called for study on same issues as Xenex petition, as well as four other areas of consideration: emergency breathing equipment, removal of smoke and toxic fumes, safe pressurization limits, and collection of medical statistics.
o May 1982	Hearing before Senate Committee on Commerce, Science, and Transportation, Subcommittee on Aviation.
o January 1983	S.197 introduced by Senator Inouye identical to S.1770.
o February 1983	H.R.1333 introduced by Congressman Heftel (Hawaii) identical to S.1770.

o November 1983	Hearing before Senate Committee on Commerce, Science, and Transportation, Subcommittee on Aviation on S.197.
o May 1984	FAA requested EPA assistance to study cabin air quality (later withdrawn due to enactment of P.L. 98-466).
o October 11, 1984	P.L. 98-466 enacted--Three more areas of consideration added: Exposure to radiation, adequacy of safety instructions, and comparison with foreign industry.
o January 29, 1985	FAA/NAS contract (DTFA01-85-C-0013) signed for $500,000.
o May 1, 1985	First NAS committee meeting.
o June 14, 1985	Public meeting by NAS for interested parties to provide data, other information, and views to committee.
o April 8, 1986	Four-month extension to the FAA/NAS contract (originally April 11, 1986) was granted at the request of NAS, with concurrence of the Committee on Commerce, Science, and Transportation.
o August 12, 1986	NAS transmitted its report, "The Airliner Cabin Environment--Air Quality and Safety," to the FAA.
o August 13, 1986	Press conference by NAS and public release of the report.
o September 19, 1986	Hearing before Senate Committee on Commerce, Science, and Transportation, Subcommittee on Aviation on NAS report.

SECTION II.

NATIONAL ACADEMY OF SCIENCES' RECOMMENDATIONS
DOT COMMENTS AND PLANNED ACTIONS

NAS Recommendation Number 1--"The Committee believes that the health effects associated with air travel should be within the purview of a Federal agency."

Comments

The Committee found that no Federal agency has direct responsibility for dealing with health effects associated with air travel.

During preparation of the report, the NAS Committee was informed that the FAA had no responsibility for the occupational health of the cabin crew. Subsequent to the issuance of the report, FAA reviewed its responsibilities regarding occupational health. The FAA Chief Counsel determined that FAA has the authority to regulate the health aspects of an aircraft in operation. Thus, this recommendation stems, to some extent, from an incomplete picture of Federal authority by the Committee.

In fact, the Department does have authority through FAA and the Office of the Secretary covering both crew and passenger health. FAA's authority is discussed at length in Appendix 2.

In addition to FAA's authority for passenger health, the Office of the Secretary is required by law to ensure that airlines provide "safe and adequate service." The courts have upheld the existing regulation of smoking in cabins under this authority. As other cabin air quality problems could reasonably fall within the statutory requirement to provide safe and adequate service, we believe that the Secretary has the authority to issue rules to protect passenger health.

We also note that the following Federal entities have health responsibilities relating to limited aspects of the cabin environment:

a. Department of Health and Human Services (Food and Drug Administration):

   Responsible for ensuring that the food, water, and waste systems on board airliners are safe and that the food that is boarded is not hazardous to health.

b. Department of Health and Human Services (Center for Disease Control):

   Responsible for identifying and stemming epidemics.

c. Department of Agriculture:

   Responsible for the inspection of food on in-bound flights from foreign points.

The responsibilities of these agencies do not conflict with those of DOT. Within each of these organizations, responsibility for air cabin health falls within the framework of their overall mandate.

Planned Action

Given the broad range of DOT authority over passenger and crew health, as well as the expertise and the nature of the missions of the other agencies which have health responsibilities, we see no reason to consolidate or transfer any authority. We recommend retention of the present system of health responsibilities.

NAS Recommendation Number 2--"The Committee found that, if the lowest rate of ventilation permitted by current equipment design were used under conditions of full or nearly full passenger loads, the resulting ventilation rate would be at the minimum determined to provide acceptable air quality when smoking is not permitted and other contaminant sources are not present. In the absence of sources of contamination, this rate does not constitute a health hazard."

Comments

This was a major finding of the Committee. This conclusion has a bearing on the recommendations cited by the Committee for further study of cabin air quality, the implementation of a data collection program that measures airflow in airplane cabins, and the proposed ban on smoking.

Planned Action

This was a finding of the committee and requires no action.

NAS Recommendation Number 3--"A data collection program that measures airflow and contamination in airplane cabins should be implemented."

Comments

In Chapter 7, "Desirability and Feasibility of Additional Data Collection," the Committee lists the principal air quality problems on aircraft that need to be evaluated. The Committee also states that ventilation rate and cabin pressure are the controlling factors for cabin air quality and concludes that actual ventilation rates should be measured under routine flight conditions in all types of commercial aircraft. The Committee then states, "If significant variations are found in an initial study, continual monitoring should be instituted."

However, the Committee also concluded that the available air quality data are insufficient to make such assumptions. This conclusion was the basis for Recommendation Number 19 that FAA establish a program to measure the various environmental factors that determine the quality of cabin air and base continual monitoring upon the results of the initial study.

Planned Action

Discussions, which began in May 1984, will be renewed with the Environmental Protection Agency. A cooperative effort will be made to determine the feasibility of initiating a practical program for making cabin air quality measurements on board airplanes during typical operations. Contaminants from all sources will be considered as a major item in the conception of this program. Another topic that will be included in these discussions is whether the many variables of flight can be monitored or controlled to correlate test results from different flight conditions.

NAS Recommendation Number 4--"The FAA standard (on carbon dioxide) is much higher than standards for other confined environments. The Committee recommends that the FAA review its carbon dioxide standard."

Comments

The carbon dioxide standard is contained 14 CFR 25.831. The FAA has reviewed the standard and found that rule originated from Civil Air Regulation 4b.371 and that there is no clear explanation why the 3 percent concentration limit was adopted.

The 3 percent concentration limit of carbon dioxide allowed in section 25.831 is double any temporary concentration value allowed by any industrial carbon dioxide concentration short-term exposure limit, and there are no time values associated with the FAA limit.

For the normal operation condition, a more appropriate approach might be to establish a ventilation rate per passenger rather than to set a specific carbon dioxide concentration limit, because there is a correlation between ventilation, passenger load, and carbon dioxide levels.

Planned Action

The FAA will review the need to establish either ventilation limits, reduced carbon dioxide limits, or both. After the review, any needed rule change and advisory material will be proposed.

NAS Recommendation Number 5--"Therefore, the Committee suggests that FAA carry out a carefully designed program to ensure that cabin ozone concentrations comply with Department of Transportation regulations."

Comments

The Committee, in its report, acknowledges that the FAA has regulations to control ozone in the aircraft cabin air, however, could find no documentation of the effectiveness of the various methods being used by the airlines to control ozone. On page 119 of the report, under RECOMMENDATIONS, it states that in 1978-1979, FAA monitored ozone concentration limits.

Based on the results of those studies, regulations were adopted that were published January 21, 1980, and became effective February 20, 1981.

The Committee further stated that "...because catalytic converters are subject to contamination and loss of efficiency, it is suggested that FAA establish policies for periodic removal and testing, so that the effective life of these units can be established. A program of monitoring is needed to establish compliance with the existing standard and to determine whether the catalytic converters are operating normally and effectively. These data should be maintained in such a manner that they can be used for reference on passenger and crew exposures to ozone and to document the concentrations of ozone."

On August 28, 1984, the FAA issued a general notice (GENOT N8320.300) to determine the status of air carrier compliance with 14 CFR 121.578, Cabin Ozone Concentration. As of November 2, 1984, information had been received on 63 operators. Fifty-two operators were complying with the rule by following operating procedures or flying at levels below 27,000 feet. Eleven operators had installed catalytic converters and had various programs to replace and/or test the efficiency of the converters.

With respect to a program to monitor ozone, the FAA conducted tests during 1978 to 1979. A total of 157 flights were sampled over a 2-year period. At that time, the FAA estimated that the number of samples would have to be increased by an order of magnitude to be statistically meaningful.

Planned Action

The FAA will issue biennial action notices, which have replaced GENOT's, requiring FAA inspectors to report on the present status of all U.S. air carriers' compliance with the existing ozone regulations, results of catalytic converter efficiency tests, and a listing of any validated complaints related to cabin ozone. The responses to the action notices will be summarized and published. Identified deficiencies will be corrected.

NAS Recommendation Number 6--"The Committee recommends a ban on smoking on all domestic commercial flights."

Comments

The Committee cited four reasons for banning smoking on all domestic commercial flights:

a. to lessen irritation and discomfort to passengers and crew;

b. to reduce potential health hazards to cabin crew associated with environmental tobacco smoke (ETS);

c. to eliminate the possibility of fires caused by cigarettes; and

d. to bring the cabin air into line with established standards for other closed environments.

The Committee noted that the irritation reported by passengers--which includes eye irritation, headaches, and coughing, among others--all affect the general health and welfare of the passengers and crew.

The Committee found ETS to be a hazardous substance having components that are toxic, carcinogenic or cocarcinogenic. The Committee found that there is a positive association between lung cancer and exposure to ETS.

While DOT agrees that the banning of smoking could marginally reduce the possibility of fires caused by cigarette smoking, we believe that recent actions by the Department, including the use of fire-blocking materials in cabins and smoke detectors in lavatories, eliminate nearly all risks of fire due to smoking.

The Committee's recommendation to ban smoking in order to bring the air quality in line with established standards for other closed environments is based on limited measurements. These data show that, in many cases, the air quality of cabin environments violate the EPA 24-hour particulate standard.

Planned Action

While we recognize that exposure to ETS could be viewed as a problem by some crew and passengers, we believe that further study is needed before the Department can propose a definitive response to this recommendation.

Issues that require further consideration include the following:

- Further review of the health effects of ETS, including review of the studies and reports completed since the NAS study.

- Further review of the concentration and distribution of pollutants for various aircraft types.

- The effectiveness and economic effects of possible technological solutions such as modifications to aircraft ventilation systems or procedures.

- Further consideration of possible application of any proposed solutions to international, as well as domestic, flights.

NAS Recommendation Number 7--"Because a likelihood of occurrence of epidemic disease when forced-air ventilation is not available on the ground has been demonstrated, the Committee recommends that a regulation be established that requires removal of passengers from an airplane within 30 minutes or less after a ventilation failure or shutdown on the ground and maintenance of full ventilation whenever onboard or ground air-conditioning is available."

Comments

As the Committee stated in its report, there has only been one documented and confirmed incident of a communicable disease spreading within an airplane on which ventilation was inoperative while repairs were attempted. The turbojet airplane had aborted takeoff departure from Homer, Alaska, due to loss of thrust in one engine. The nature of the repairs necessitated removal of the ground ventilation system for the cabin interior. Passengers were offered a choice of deplaning to the somewhat rudimentary terminal or remaining on board the airplane. Either choice apparently offered approximately the same degree of protection from the elements. The outside temperature was slightly below freezing. Some of the passengers did elect to wait out the delay in the terminal.

One passenger, who had boarded at Homer and elected to remain on board, was afflicted with early stages of influenza. All of the passengers who remained on board were afflicted with influenza in varying degrees of severity within a few days. None of the passengers from the terminal contracted the illness during the resumed flight to Kodiak on a substitute, normally ventilated airplane. The conclusion was that the illness had been transmitted throughout the grounded airplane due to lack of ventilation.

DOT agrees that confinement in an unventilated enclosure (room, car, bus, etc.) will facilitate spread of epidemic disease. Because the occurrence of complete ventilation cessation on passenger-laden airplanes is extremely rare, and as in the Homer case, unavoidable, we do not believe that regulatory action is necessary. Unlike Homer, the cessation is usually very brief. The duration of such instances is likely to be less than 30 minutes.

Planned Action

While the risk of occurrence of complete ventilation cessation on passenger-laden airplanes is extremely low, we believe that there may be value in bringing this concern to the attention of the air carriers. The FAA will advise air carriers of the need to deplane passengers, if possible, after 30 minutes without ventilation.

NAS Recommendation Number 8--"The Committee also recommends that maximal airflow be used with full passenger complements to decrease the potential for microbial exposure and that recirculated air be filtered (to remove particles larger than 2-3 um) to reduce microbial aerosol concentrations."

Comments

Maximal airflow is used on a regular basis today in airline operations. During the past fuel crisis, there was a common practice of shutting off air-conditioning packs to conserve much needed fuel. With all of the air-conditioning packs operating, the current fleet of airplanes exceeds or equals The American Society of Heating, Refrigerating, and Airconditioning Engineers, Inc. (ASHRAE) Standard 62-1981 of 7 CFM for auditoriums, theaters, and other nonsmoking spectator areas.

Older jet transports were designed to deliver a cabin fresh air ventilation rate of 15 to 20 cubic feet per minute (CFM) per passenger. Newer airplanes, such as the Boeing 757 and 767, were certificated with a mixture of air consisting of approximately 10 to 15 CFM of fresh air and 5 to 10 CFM of recirculated air. All of the newer aircraft incorporate some form of filtration for the recirculated air and are already being delivered with the 2-3 um (one-millionth of a meter) or better hospital-type filters.

DOT does not have a data base of reports of the spread of illness or disease within the airplane cabins that are ventilated by environmental control systems operating at design levels. DOT agrees with the Committee's statement on page 159 of its report that "Microbial concentrations have not been measured in aircraft, and therefore accurate risk assessments cannot be made." As discussed under Recommendation Number 19, there is merit in making cabin air quality measurements, including concentrations of microbial aerosols. These measurements would be taken with different levels of cabin airflow to establish a correlation between microbial concentrations and the amount of airflow. Once this correlation is established, the health effects of marginal airflow can be established.

Planned Action

The program for making cabin air quality measurements identified under Recommendation 19 will include microbial aerosol concentrations at different cabin airflows. Whether or not maximal airflow is required at all times will be evaluated at the conclusion of this measurement program.

NAS Recommendation Number 9--"The Committee concluded that current pressurization criteria and regulations are generally adequate to protect the traveling public. However, the medical profession should use a more efficient system to warn those with existing medical conditions who are more susceptible to changes in pressure or to long exposure to low pressure that there might be some hazard to their health."

Comments

DOT concurs with the Committee's conclusion that the current pressurization criteria and regulations are adequate to protect the traveling public with the exception of a very small percentage of those with preexisting medical conditions that increase their susceptibility to changes in the partial pressure of oxygen and cabin pressurization. Because of the possibility of an in-flight medical emergency secondary to a preexisting condition, the FAA requires the availability of supplemental oxygen for first-aid use. Crewmember training in the care of passenger's conditions that may result secondary to the in-flight environment is also required. The responsibility of warning patients with such medical conditions is considered to be that of the patient's physician. The FAA has an ongoing program to educate that segment of the medical profession with which it has direct contact (FAA-designated Aviation Medical Examiners), and it also encourages the publication of articles concerning aviation medicine in medical journals as an adjunct to the educative effort.

Planned Action

The FAA will continue its ongoing effort to provide aviation medical information to the members of the medical profession to enhance their ability to advise those patients at risk concerning possible hazards secondary to the in-flight environment. In addition to direct contact with FAA-designated Aviation Medical Examiners, the FAA will continue to encourage publication of such information in medical journals. The FAA will ask the American Medical Association to republish the excellent article "Medical Aspects of Transportation Aboard Commercial Aircraft" (Journal of the American Medical Association, February 19, 1982, Volume 247, Number 7) (Appendix 3).

NAS Recommendation Number 10--"FAA should consider rule-making that restricts exposure [to cosmic radiation] of pregnant flight crew and cabin crew members. In addition, FAA should investigate total radiation exposure of flight crew and cabin crew members through the use of a statistical sample of full-time employees and should require airlines to provide precautionary information to their flight attendants about radiation exposure."

Comments

The FAA has been interested in the effects of increased natural ionizing radiation since the early planning stages of civil supersonic transportation. Because of research efforts in this area, much data have been gathered pertaining to the extent and effects of radiation at supersonic and subsonic aircraft flight altitudes. Since the initiation of supersonic passenger flight on the Concorde, actual radiation exposure has been monitored during flight and documented. Operational experience over the past 8 years with Concorde aircraft operated by Air France and British Airways has proven conclusively that the risk of exposure to radiation to passengers and crewmembers is very low. Since the amount of radiation is related to altitude, there is even less exposure in the operation of subsonic aircraft.

Galactic radiation is predictable in relation to altitude and latitude. The radiation from solar flares is not predictable, but subsequent exposure can be minimized once the event occurs by avoiding high altitude, high-latitude flights.

Crewmembers at risk of exceeding the 500 millirems annual limit represent only a very small percentage of those engaged in the air carrier industry. Since the radiation environment at flight altitudes is well defined and reasonably predictable, the expense and burden of mandatory radiation controls and monitoring are not realistic.

Air carrier crewmembers, in most cases, have the unique opportunity to vary their occupational scheduling as related to high-altitude, high-latitude flights. This is particularly significant in the case of crewmembers who are pregnant or may have been exposed to solar flare activity. With appropriate advisory information and management cooperation, crewmembers will have the option to limit their exposure to cosmic radiation by discrete scheduling within domestic and flag route systems. The FAA has considered rulemaking and finds that there is insufficient evidence to justify it. Appropriate scheduling by flight attendants can eliminate the threat perceived by the NAS.

Planned Action

The FAA is currently developing advisory information to promote radiation safety through educational initiatives for use by the air carrier industry. This information will be distributed, and with management cooperation, crewmembers concerned with radiation exposure will be able to limit such by scheduling within domestic and flag route systems.

NAS Recommendation Number 11--"The Committee approves of current efforts to base passenger safety briefings and written materials on empirical testing of comprehension and retention."

NAS Recommendation Number 12--"The Committee suggests that FAA or appropriate industry organizations consider the advisability of developing an empirical research program to examine passenger response to safety instructions under routine and emergency conditions and revise them as appropriate. Consideration should be given to running some quizzes during a flight to see, for example, what proportion of passengers have retained the key features of the safety briefing."

Comments

Air carriers are encouraged to make the required preflight and optional in-flight and prelanding briefings understandable and motivational in nature. The guidance concerning these briefings is contained in Advisory Circular 121-24 (Appendix 4), which is designed to standardize and improve the safety information presented to passengers by the airline industry. Guidance is provided concerning the preparation of comprehensive oral briefings and written passenger briefing cards. The accepted practice of both the FAA and the airline industry is that briefings concerning emergency actions should not create passenger apprehension or inspire unwarranted actions by the passengers. AC 121-4 is currently being revised to include the latest state-of-the-art in briefing techniques and technological advances.

Attentive passengers who have received the preflight briefings could "pass" quizzes given during nonstressful flight situations, however, that does not necessarily mean that they will take the correct action in a given emergency situation. Cabin attendants, who have received hands-on, simulated emergency training, including techniques for disoriented and panicky crowd control, have the dominant role in emergency situations over passengers who have received only indoctrinational type briefings. The emergency procedures for passengers are, therefore, relatively passive (i.e., follow instructions given for their individual protection) while trained crewmembers implement procedures and deploy any required equipment necessary to assure the continued safe flight and landing of the airplane and the safety of the passengers.

The FAA has considered the advisability of developing an empirical research program as recommended and finds no basis in the NAS report or elsewhere to justify the research. The FAA is deeply interested in suggested improvements for briefing techniques from the airline industry, but requiring a quiz data base is inappropriate.

Planned Action

The FAA will continue to update AC 121-24 as necessary.

NAS Recommendation Number 13--"The Committee recommends that FAA require that information on proper response to fire emergencies be included in oral and written passenger safety information."

Comments

Federal Aviation Regulations 14 CFR 121.571 and 135.117 contain the requirements for briefing air carrier passengers. The guidance for operators of airplanes having a seating capacity of more than 30 passengers and for FAA inspectors is contained in Advisory Circular 121-24.

AC 121-24 was designed to standardize and improve the safety information presented to passengers by the airline industry. Guidance is provided in the AC concerning the preparation of comprehensive oral briefings and written passenger briefing cards. The accepted practice of both the FAA and the airline industry is that briefings concerning emergency actions should not create passenger apprehension or inspire unwarranted actions by passengers. The emergency procedures for passengers are, therefore, relatively passive (i.e., follow instructions given for their individual protection) while trained crewmembers implement procedures and deploy any required equipment necessary to assure the continued safe flight and landing of the airplane and the safety of the passengers.

Recent occurrences of unwarranted passenger-initiated emergency evacuations have caused concern that preflight briefings may in some cases motivate some people to act independently and unnecessarily. When trained cabin crewmembers are present, the best course of action is for the passengers to remain seated while specialized crew action is accomplished to alleviate smoke or fire.

At the present time, the only special equipment or procedures for passenger usage are for airplanes of 19 passengers or less, which have no cabin crew and are operated under 14 CFR Part 135. In these operations, the pilot in command must comply with 14 CFR 135.117 and adequately brief passengers to accomplish emergency procedures in the event of cabin fire, to assure continued safe flight and landing and subsequent evacuation.

Planned Action

The FAA will continue the present practice.

NAS Recommendation Number 14--"The Committee feels that continuing research (fire safety) is also needed in materials development."

Comments

As the basis for this recommendation, the Committee states on page 10 of its report, "In general, the FAA program on flammability testing is excellent, and its research efforts to improve testing methods are appropriate and valuable. The recently issued FAA flammability standards for seat cushions and cargo compartment liners will reduce in-flight and postcrash fire hazards." "...Although FAA standards are met by currently available materials, other materials exist that, with further development, would far exceed current standards and would provide substantially increased fire protection in aircraft."

Continuing research is needed in the development of improved fire-safe materials. The FAA's part in this research generally entails the analysis of fire-safety problems and the development and validation of practical small-scale test equipment that can be used to measure reliably the relative fire-safety characteristics of materials. Using this test equipment, the FAA cooperates with material producers, interior fabricators, aircraft manufacturers, and airlines in the development and adaptation of new materials which have a high level of fire safety as well as durability, cleanability, appearance, and other practical characteristics necessary for economically competitive materials.

Recent examples of this highly-successful, cooperative approach between FAA and industry include the establishment of new standards for heat-resistant evacuation slide materials, cargo compartment fire barrier liner materials, fire-safe seat cushion materials, and cabin wall and ceiling panel materials.

Planned Action

The FAA plans to continue this approach in the development of improved materials and believes that this action is responsive to the Committee's recommendation.

NAS Recommendation Number 15--"The Committee noted that current emergency procedures for smoke removal recommend that the cabin be depressurized to 10,000 ft. This procedure is ineffective and should be discontinued."

Comments

The Committee on Airliner Cabin Air Quality presented the following reasoning: "All procedures the Committee reviewed specified increasing cabin altitude to 10,000 ft. to increase ventilation. Although that will increase the volume of air flowing through the cabin, the lower pressure will also increase the volume of smoke produced by a given fire, and there would be little or no reduction in smoke concentration. Any reduction in burning rate due to the decrease in partial pressure of oxygen in the cabin is insignificant."

Mass airflow is generally controlled by the pressurization schedule and the characteristics of the bleed air system. The significance of combined changes in air density, air velocity, and airmass flow on burning rates or smoke production is unknown. There may be too many unpredictable variables to draw any justifiable conclusions.

On September 29, 1986, the FAA issued Advisory Circular (AC) 25-9, Smoke Detection, Penetration, Evacuation Tests and Related Flight Manual Emergency Procedures (Appendix 5). This new AC provides guidelines for the conduct of certification tests relating to smoke detection, penetration, and evacuation procedures. The AC also provides guidelines to evaluate related airplane flight manual procedures.

AC 25-9 has been reviewed, and it has been determined that paragraph 5b is too general relative to smoke evacuation procedures. The paragraph should be more specific and note the limitations of smoke procedures.

Planned Action

The FAA will obtain and review additional information that is known to address the smoke evacuation issue. This will include a Lockheed study that investigated decompression as a means to control or extinguish a fire, pertinent information retained by the cognizant aircraft certification offices, and any additional information from the NAS. NTSB in-flight smoke and fire accident/incident reports will also be reviewed. Based on this review, the FAA will determine the effectiveness of the current procedures for smoke removal.

AC 25-9 will be revised to be more specific relative to decompression procedures and include any limitations on their use, or other appropriate actions as determined to be necessary will be taken.

NAS Recommendation Number 16--"However, there are generally more crew members than fire extinguishers, and the Committee recommends that FAA review the proposed rule on protective breathing devices for crew members to ascertain the desirability of supplying such equipment for all crew members, rather than limiting it to the persons expected to be involved in firefighting. In addition, the Committee suggests further evaluation of the potential of emergency breathing equipment for all cabin crew members to improve safe and expeditious evacuation of passengers in fire emergencies."

Comments

The NAS report made note of current FAA Notice of Proposed Rulemaking (NPRM) 85-17 (Appendix 6) concerning protective breathing equipment (PBE) for crewmembers. NPRM 85-17 was published in the Federal Register for public comment on October 10, 1985, with a closing date of February 10, 1986. The proposed rulemaking stemmed from recommendations made by the National Transportation Safety Board concerning accidents caused by in-flight fires. Therefore, the thrust of the proposed rule is to provide protection for persons directly involved in addressing cabin smoke and fire while in flight.

The recommendation to evaluate the potential of emergency breathing equipment for all cabin crew members to improve safe and expeditious evacuation of passengers will not be addressed as part of the above discussed rulemaking but will be addressed as part of Recommendation Number 17 to reexamine passenger protective breathing devices.

The fighting of a fire presents significant workload demands that dictate the design of the protective breathing devices provided for that purpose. When the cabin crewmembers are not fighting an in-flight fire, their needs for protective breathing equipment would be similar to those of the passengers.

Planned Action

The evaluation of the potential of emergency breathing equipment for all cabin crewmembers to improve the safe and expeditious evacuation of passengers in fire emergencies will be conducted in conjunction with the planned action on Recommendation Number 17.

NAS Recommendation Number 17--"The Committee recommends that FAA re-examine passenger protective breathing devices and consider requiring that such equipment be available in case of in-flight and postcrash fires."

Comments

The FAA concurs with the Committee's recommendation to restudy the issue based on current technological developments throughout the world. The FAA is currently reviewing this new technology with representatives of the Civil Airworthiness Authorities of Canada, France, and the United Kingdom.

On July 29, 1986, the FAA received a letter from the United Kingdom's Civil Airworthiness Authority, including a specification for passenger protective breathing equipment (PBE) for both in-flight and postcrash fires. The Canadians have also been conducting research on passenger PBE as a result of the Cincinnati accident. The Canadian's work is referenced in the NAS report. In addition, the FAA learned that France is conducting testing in passenger PBE.

A meeting was held between representatives of the four countries in Redhill, England, September 29, 30, and October 1, 1986, to discuss research and development (R&D) and to develop a consolidated, cooperative plan to conduct the necessary R&D to reinvestigate the technical safety merits of PBE.

The general consensus of the meeting was that two scenarios need to be investigated, in-flight and postcrash. The representatives decided that before any regulatory action could be contemplated, it would be necessary to identify the need, establish candidates' scenarios, identify test objectives, and establish detailed pass/fail criteria.

Planned Action

This joint international effort on passenger protective breathing equipment will continue. Several meetings have been held during the last 6 months. The groups' objective is to perform a worldwide accident and incident analysis to fully summarize fire events and human factors, in order to evaluate the safety potential of individual passenger protective breathing devices under different fire scenarios. The group will also begin development procedures for testing the devices.

A meeting will be held in May 1987 between the four nations to decide on further activity. Once this international effort is completed, the FAA will assess the need for regulatory action.

NAS Recommendation Number 18--"The Committee was charged with performing a comparison of foreign industry practices, regulations, and standards, and has gathered relevant information applicable to the issues addressed in this study. Although some differences from those in the United States have been noted, they do not appear to be significant. The Committee feels that greater effort along these lines is not warranted."

Planned Action

This recommendation requires does not require DOT action.

NAS Recommendation Number 19--"The Committee therefore recommends that FAA establish a program for the systematic measurement, by unbiased independent groups, of the concentrations of carbon monoxide, respirable suspended particles, microbial aerosols, and ozone and the measurement of actual ventilation rates, cabin pressures, and cosmic radiation on a representative sample of routine commercial flights. These findings should be subjected to peer review."

Comments

(NOTE: The term "program" as used in this recommendation is interpreted to mean a one-time study.)

In 1970 and 1971, FAA and the U.S. Public Health Service (PHS) conducted a study of the health aspects of smoking in passenger-carrying aircraft. The study involved the measurement of tobacco combustion by-products, including carbon monoxide, smoke particulates, aromatic hydrocarbons, aldehydes, and ketones on 20 military airlift command international flights and 14 domestic civilian flights. The results revealed very low levels of each contaminant measured, much lower than those recommended in occupational and environmental air quality standards. This was the earliest effort to evaluate air contaminants in passenger-carrying aircraft.

The Committee cited other tests that were performed by airlines and individuals, including "measurements of opportunity," made by some of the Committee members. In most instances, carbon monoxide and respirable suspended particles of environmental tobacco smoke were measured. Carbon monoxide levels far below ambient and occupational standards were reported. There are no established standards for smoke particles.

The levels of microbial aerosols (e.g., viruses, bacteria, molds, and fungi) that may exist in airliner cabins were not considered in either the FAA/PHS 1970-71 study or in subsequent tests. Recent indoor air pollution investigations have revealed that a wide variety of microbial contaminants are commonly found in occupied, enclosed spaces such as modern office buildings. Presumably, such would be the case in any closed environment where people congregate, and passenger-carrying aircraft would be no exception. Despite the fact that there are no standards limiting the kinds and concentrations of microbes in such places, the Committee stated that "...in view of the degree of expressed concern about microbial contamination in aircraft and the possibility that serious acute health effects could result from such contamination, it is important to collect baseline data on background concentrations of microbial aerosols during normal flight conditions."

The FAA/PHS 1970-71 study of tobacco smoke contamination in aircraft has been labeled by some as "inadequate." However, the limited data that have been collected in subsequent less-structured testing, prior to the NAS study, have done little to refute the conclusion reached in the early study, i.e., that, based on environmental levels and expected dose-response relationships of contaminants, tobacco combustion products do not represent a hazard to the nonsmoking passengers.

Data obtained with the computer model developed by the Committee were found to be supportive of the limited empirical data. All of the data suggested that "...cabin air is probably no worse than air in many other confined environments." This conclusion by the Committee was based on data that did not consider the potential for microbial aerosol contamination.

The technology for measurement of the environmental factors associated with cabin air quality has made tremendous strides since the 1970-71 FAA/PHS study. Also, the experimental designs used in that and the other studies cited by the Committee were probably less than adequate. Designing and conducting new studies using more sophisticated investigative techniques could increase the level of confidence in the measurements obtained.

Planned Action

Discussions, which began in May 1984, with the Environmental Protection Agency will be renewed regarding the advisability and feasibility of initiating a practical program for making cabin air quality measurements on board airplanes during typical operations.

NAS Recommendation Number 20--"The Committee recommends that FAA establish a program to monitor selected health effects on airliner crews."

Comments

Acting under its responsibility for the occupational safety or health of aircraft crewmembers, the FAA has issued numerous regulations directly affecting the workplace of pilots, flight engineers, cabin attendants, and other persons whose workplaces are on aircraft in operation. These regulations cover aircraft performance and structural integrity, safety equipment for emergency ditching and evacuation, fire protection, protective breathing equipment, and emergency exits. Other regulations affecting the crewmember workplace have been issued with respect to cockpit lighting, crewmember seat belts, toxicity and other characteristics of materials in the crewmember workplace, and other environmental factors affecting that workplace, including noise reduction, smoke evacuation, ventilation, heating, and pressurization. Maximum hours of duty and duty aloft for air carrier flight crewmembers are also regulated, as is the protection of crewmembers from radioactive and other hazardous materials.

Although the FAA has no reporting requirement for crewmember disease that may be occupationally related, there are data available on in-flight crewmember injuries. The FAA also requires periodic physical examination on flight crewmembers; however, there is no such requirement for flight attendant crewmembers. There is no conclusive evidence of increased incidence of disease related to crewmember duties.

The type of monitoring program the NAS report recommends would attempt to identify health effects of the working environments on cabin crewmembers. In making the recommendation to examine rates of spontaneous abortion and birth defects among cabin crewmembers, the NAS report identifies the difficulty of studying such a complex, phenomena where it is difficult to separate the effects of the cabin environment from other environmental or hereditary effects. The NAS report indicates difficulties in interpreting the results that will occur and recommends that "a feasibility study be undertaken to determine whether these conditions can be met." The FAA will discuss with the National Institute of Occupational Safety and Health (NIOSH) the feasibility of establishing a program to monitor selected, health effects on airline crews.

Planned Action

The FAA will continue its efforts to ensure the occupational health and safety of crewmembers in response to established needs. The FAA will discuss with NIOSH the feasibility of establishing a program to monitor selected health effects on airline crews.

NAS Recommendation Number 21--"The Committee recommends that FAA collect these data (uses of recently mandated medical kits) in such a way as to permit comparison of onboard incidents with those in other settings."

Comments

FAR Amendment Numbers 11-29 and 121-188 (Appendix 7), which contain the requirement for the carriage of emergency medical equipment on air carrier aircraft, became effective August 1, 1986. New 14 CFR 121.715, included in these amendments, requires that for a period of 24 months, each certificate holder will maintain records on each medical emergency occurring during flight time resulting in the use of the emergency medical equipment, diversion of the aircraft, or death of a passenger or crewmember. These records will include how the medical kit was used, by whom, and the outcome of the medical emergency. This information will be submitted to the FAA within 30 days after the end of each 12-month period during the 24 months of required reporting. This existing data collection program is fully responsive to the NAS recommendation.

Planned Action

The FAA will use the data required by 14 CFR 121.715 to determine future need for the carriage of emergency medical equipment on air carrier aircraft. This data will be available for use in studies comparing medical incidents on board air carrier aircraft with those in other settings. The FAA will not undertake these comparative studies since it does not have the authority. Such studies would be inappropriate for the FAA.

APPENDIXES

Public Law 98-466
98th Congress

An Act

To direct the Secretary of the Department of Transportation to conduct an independent study to determine the adequacy of certain industry practices and Federal Aviation Administration rules and regulations, and for other purposes.

Oct. 11, 1984
[S. 197]

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

Aircraft and air carriers.
Health.
Safety.
49 USC app. 1803 note.

SECTION 1. (a) The Secretary of Transportation shall, in the interest of health and safety, and in the interest of promoting and maintaining a superior United States aviation industry, commission an independent study by the National Academy of Sciences. The study shall determine whether civil commercial aviation industry practices and standards and Federal Aviation Administration rules, regulations, and minimum standards are nondiscriminatory and at least in conformance and parity with nonaviation standards, practices, and regulations for the appropriate maintenance of public and occupational health and safety (including de facto circumstances) in relation to airline cabin air quality for all passengers and crew aboard civil commercial aircraft.

(b) In conducting the study, special and objective considerations shall be given to the uniqueness of the environment onboard civil commercial aircraft. The study shall focus on all health and safety aspects of airline cabin air quality, including but not limited to—

(1) the quantity of fresh air per occupant and overall quality of air onboard;

(2) the quantity and quality of humidification;

(3) onboard environmental conditions and contamination limits, including exposure to radiation;

(4) emergency breathing equipment, including toxic fume-protective breathing equipment;

(5) measures, procedures, and capabilities for detecting and extinguishing fires and the removal of smoke and toxic fumes within safe pressurization limits;

(6) safe pressurization of the aircraft, considering the broad range of cardiopulmonary health of the traveling public, and dissemination of information to the medical profession and the general public of current pressurization limits and practices to assure valid medical advice concerning the health effects of air travel;

Public information.

(7) the feasibility of collection and dissemination by the aviation industry, the Federal Aviation Administration, or any other private or governmental organization of a data base of medical statistics and environmental factors relating to air travel, including but not limited to, maintenance and operation records and procedures of aircraft, in an effort to assess the adequacy of aircraft systems, design, regulations, standards and practices relating to airline cabin air quality from the standpoint of health and safety, and for the purpose of issuing Federal Aviation Administration administrative advisory circu-

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lars and airworthiness directive regulations to correct any deficiencies disclosed;

(8) the adequacy of current preflight and inflight health and safety instructions for air travelers that relate to airline cabin air quality, including but not limited to, life safety procedures during inflight fire, smoke, and toxic fume emergencies; and

(9) a comparison of foreign industry practices, regulations, and standards.

(c) In conducting the study, special care shall be taken to assure that all existing studies, recommendations, data, and state of the art technology relevant to the health and safety aspects of airline cabin air quality are considered.

(d) In conducting the study, the National Academy of Sciences shall consult with and solicit the views of academic experts, representatives of airline labor, the aviation industry and independent experts and organizations.

(e) The study shall include such recommendations for legislative, regulatory, and industry changes as the National Academy of Sciences determines to be advisable for promotion of health and safety in relation to airline cabin air quality.

49 USC app. 1303 note.

SEC. 2. The Secretary of Transportation shall submit a copy of the study, as it was prepared by the National Academy of Sciences, to the Congress within eighteen months after the date of enactment of this Act. At such time the Secretary shall also set forth such comments on the matters covered by the study and such recommendations for legislative, regulatory, and industry changes as the Secretary determines to be necessary.

Appropriation authorization. 49 USC app. 1303 note.

SEC. 3. There is authorized to be appropriated not to exceed $500,000 for the fiscal year commencing October 1, 1984, to carry out the study authorized by this Act. Such funds shall remain available for obligation until expended.

Approved October 11, 1984.

LEGISLATIVE HISTORY—S. 197:

SENATE REPORT No. 98-468 (Comm. on Commerce, Science, and Transportation).
CONGRESSIONAL RECORD, Vol. 130 (1984):
June 15, considered and passed Senate.
Oct. 1, considered and passed House.

U.S. Department of Transportation
Federal Aviation Administration

Memorandum

Subject: INFORMATION: National Academy of Sciences Recommendations on Cabin Air Quality; Re: Recom. 20, Does FAA Have Responsibility/Authority for Cabin Attendant Health?

Date: OCT 20 1986

From: Manager, General Law Branch, AGC-110

Reply to Attn. of: WALSH:267-3362

To: Director, Office of Aviation Medicine, AAM-1

> "The committee recommends that FAA establish a program to monitor selected health effects on airliner crews"

Some question has been raised about the FAA's authority to deal with this recommendation. In a Federal Register Notice, dated July 10, 1975, the agency asserted that-

> Every factor affecting the safe and healthy working conditions of aircraft crew members involves matters inseparably related to the FAA's occupational safety and health responsibilities under the [Federal Aviation] Act. With respect to civil aircraft in operation, the overall FAA regulatory program, outlined in part above, fully occupies and exhausts the field of aircraft crew member safety and health.

40 F.R. 29114.

The question was raised at a recent meeting as to whether Jonathan Howe, then ANM-2, rescinded this assertion in testimony before the Burton subcommittee at San Francisco, in 1980. My review of the hearing transcript satisfies me that he did not do so. In his prepared statement, Howe said-

> Because of the FAA's air safety mission and the pervasive regulatory scheme we have in place concerning aircraft design and operations, we have asserted full jurisdiction over health and safety requirements of aircraft in flight.

Hearing Transcript, 188.

In response to questioning, Howe reaffirmed the agency's position, as follows-

> Mr. Walker. But the point is that on the one hand, FAA is making it very clear that you have full jurisdiction in health and safety requirements in aircraft [in] flight. That is not an area that you are going to concede to OSHA no matter what?
>
> Mr. Howe. That is true. That is correct.

Hearing Transcript, 184.

The sum of the foregoing is, I believe, that we are still on record as asserting that we have authority to regulate concerning health hazards occurring in aircraft in operation, and that certain actions we have taken in the past constitute exercises of that authority. In assessing our position today, however, it is well to take account of the situation that gave rise to these pronouncements.

In the 1975 time frame we were, at the behest of OST, specifically TES-10, engaged in a "turf" battle with OSHA. Our FR Notice was prompted by that consideration more than any other. Under Section 4(b)(1) of the Occupational Safety and Health Act, OSHA was asserting its authority to regulate hazards left unattended by other agencies even though the other agency had statutory authority to regulate the hazard. For instance, OSHA representatives asserted in a meeting that they had, and would not hesitate to exercise, the authority to require airline pilots to wear parachutes. They argued that the only way for the FAA to prevent such an event would be for us to "exercise" our admitted authority over the matter, as by adopting a rule that declared parachutes unnecessary. This position was based on the fact that Section 4(b)(1) of the OSHAct, which operates to limit OSHA jurisdiction, requires that the ousting agency "exercise" its authority; merely having the authority is not enough.

The atmosphere today is significantly different. OSHA has no interest in regulating the aviation industry. As a result of the decision of the Occupational Safety and Health Review Commission in the Northwest Airlines case, OSHA lawyers have taken the position that there is, practically speaking, an industry exemption for the airline industry. Similarly, in a 1980 letter denying a research grant to study the effects of flying as an

occupation on the health of flight attendants, the Administrator of OSHA said-

> "OSHA is unable to provide funding to study the working conditions of flight attendants [because] "Program activities involving workplaces that are largely precluded from enforcement action...under Section 4(b)(1)..." are nonsupportable under this program.

Letter to NIOSH, Jan 11,1980.

Thus, there is no need for us to overstate the extent of our authority merely to keep OSHA at bay. The question remains, however, whether our statute gives us the authority to regulate conditions affecting health alone, or whether there must be some connection with safety.

Whether we can "monitor" health effects as recommended when there is no connection with safety of flight appears on the surface of our statute to be questionable. In connection with that question, I have cursorily reviewed the notices and amendments involved with the "ozone rule," and with the smoking issue. The actions taken with regard to ozone appear to have been based exclusively on health considerations, especially in view of the fact that passenger comfort seems to have been a prime consideration for their adoption. Nevertheless, I do note that the actions required of the regulated persons affected by the rule involve either modification of the aircraft or changes in operational factors that could be considered safety-related and, therefore, within the exclusive purview of the FAA. In this connection, however, it cannot be overlooked that the FAA formally asserted authority to regulate smoking solely in the interest of passenger health, withdrawing from that action only because there was not sufficient evidence of adverse effects to support it, at that time. See, Notice 70-14, and the withdrawal of same.

Of further, and perhaps controlling, interest is the recent decision of the Court of Appeals for the D.C. Circuit in the medical kit case, Bargmann v. Helms. The court held in that case, despite our protestations to the contrary, that the FAA has the authority to require air carriers to carry medical kits aboard that are stocked with medicines and other materials necessary for the treatment of diseases and other ailments or infirmities among passengers which are not caused, or necessarily even aggravated, by flying.

Finally, I have found nothing to indicate that any other government agency may have jurisdiction over health issues arising from employment on aircraft in operation. It is worth noting, however, that any such authority, should it exist, would hardly exclude the FAA from concurrent jurisdiction over the same conditions.

In conclusion, in answer to the questions raised at the meeting with Tony Broderick, I believe we do have authority to regulate the health aspects of employment on aircraft in operation. There is not, however, any legal compulsion to exercise that authority in any particular manner as to any particular health hazard. As the court said in Bargmann v. Helms, " [w]e hold only that the agency has the power of decision [to require or not to require the expanded medical kits]; the decision itself must be made by the FAA." Whether we believe that OSHA's apparent abdication in this area imposes a moral or political obligation on the FAA is left to the judgment of others.

JOHN M WALSH

Special Communication

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Medical Aspects of Transportation Aboard Commercial Aircraft

AMA Commission on Emergency Medical Services

AIR TRANSPORTATION is relatively safe: the death rate during flight for the period 1976 to 1979 was one per 6.4 million revenue passengers, with approximately one flight diversion for medical reasons per 10,000 scheduled flights. However, the incidence of nonfatal medical emergencies is unknown. Transport by air of patients who are not critically ill is expeditious, safe, comfortable, and convenient.

Airline travel presents two major problems to the medical profession: (1) What advice should be given to a patient who wishes to travel by air? (2) How should the physician respond to emergencies that arise during a flight on which the physician himself is a passenger, and how are common in-flight emergencies handled?

Following is a brief review of the principles of high-altitude flight, the potential effects on medical and surgical conditions, and recommendations for care of problems that occur in flight.

AIRCRAFT OPERATIONAL CONSIDERATIONS

A modern jet airliner flies at cruising altitudes from about 28,000 ft to 43,000 ft and, rarely, even to 45,000 ft. As altitude increases, the atmospheric pressure decreases from 760 mm Hg at sea level (14.7 psi) to 176 mm Hg (3.40 psi) at the typical operational level of 35,000 ft (Table 1). Aircraft are pressurized with atmospheric air by use of compression to avoid problems such as decreased partial pressure of oxygen and expansion of gases within the passenger's body.

However, aircraft are not pressurized to sea level but to a differential of approximately 8.6 psi. Assuming a flight at 35,000 ft where the atmospheric pressure is only 3.40 psi, the cabin compressor adds another 8.6 psi. The ambient pressure is 3.4 psi plus 8.6 psi, or 12.0 psi, which is the atmospheric pressure at 5,500 ft above sea level. Similarly, the cabin pressure at 40,000 ft is 2.72 psi plus 8.6 psi, or a psi of 11.32, equivalent to an altitude of 7,500 ft.

The partial pressure of oxygen in the cabin therefore is always decreased above a flight level of 22,500 ft. The alveolar P_{O_2} of a person with normal lungs is 107 mm Hg at sea level, where the atmospheric P_{O_2} is 159 mm Hg. However, at the 5,000-ft level simulated by pressurized aircraft actually flying at 35,000 ft, the atmospheric P_{O_2} has dropped to 130 mm Hg and the alveolar P_{O_2} to 76 mm Hg; at a simulated cabin pressure of 8,000 ft, the atmospheric P_{O_2} is 116 mm Hg, and the alveolar P_{O_2} level is only 59 mm Hg. This reduction in oxygen pressure is a major consideration in transport of patients with impaired cardiopulmonary function.

The vulnerability of a patient to hypoxemia at altitude depends on the alveolar or arterial P_{O_2} of the patient at sea level and the physiological ability to compensate for a decrease in P_{O_2} as the plane ascends (Table 2). A low P_{O_2} together with possible acidosis may cause intermittent pulmonary hypertension and associated ventilatory or cardiac decompensation. Therefore, patients with low vital capacity or pulmonary diffusion impairment are at risk during air travel.

Recommendations

All patients with chronic cardiovascular or pulmonary problems such as cystic fibrosis, chronic emphysema, cyanotic congenital heart disease, chronic asthma, coronary insufficiency, or fibrotic pulmonary conditions should have supplemental oxygen at all times during flight at levels above 22,500 ft.

The arterial blood gases should be measured before the flight if a patient appears clinically to have a compromised cardiopulmonary sta-

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Reprint requests to the Commission on Emergency Medical Services, American Medical Association, 535 N Dearborn St, Chicago, IL 60610 (Gary B. Schwartz, Secretary).

Members of the Air Emergency Task Force include the following: Willis A. Wingert, Jr, MD, Chairman; John E. McDermott, MD; Paul S. Mesnick, MD; and Leo R. Schwartz. Robert W. Gillespie, MD, is chairman of the Commission on Emergency Medical Services.

Table 1.—Comparative Values due to Pressure Changes*

Altitude of Aircraft, ft	Atmospheric Pressure, psi	Atmospheric Pressure, mm Hg	Cabin Pressure, psi†
40,000	2.72	140	11.32
35,000	3.40	176	12.00
30,000	5.46	282	14.06
22,500	6.10	315	14.70
15,000	8.30	429	14.70
10,000	10.11	523	14.70
5,000	12.20	630	14.70
Sea level	14.70	760	14.70

*From the Cardiovascular Committee of the Cystic Fibrosis Foundation.[1] Table 1 is reproduced with permission from *Pediatrics* (1976;57:408-410), © 1976 American Academy of Pediatrics.
†Maximum 8.6 psi differential.

Table 2.—Altitude's Effect on Blood Gas Values in Normal Patients*

Altitude, ft	Atmospheric Po_2, mm Hg	Alveolar Po_2, mm Hg	Arterial Blood Po_2, mm Hg
Sea level	159	107	98
1,000	153	102	90
2,000	146	96	96
4,000	137	84	90
6,000	125	71	84
8,000	116	59	55

*From Cowan.[2] Table 2 is reproduced with permission from Cliggott Publishing Co (*Consultant*, July 1979, vol 19, No. 7, pp 67-73).

tus. Arterial Po_2 should be above 50 mm Hg. If the patient with low Po_2 must fly, consultation with the airline surgeon and provision of a suitable face mask to deliver 25% to 30% humidified oxygen is recommended. All airlines carry emergency oxygen and most will supply oxygen to individual passengers, with 48 hours' advance notice. The flow is generally limited to 4 L/min and is dependent on mask design. The quantity to be carried depends on the duration of the flight and the patient's Pa_{O_2} at ground level. Consultation with the medical department of the airline is essential before advising relatively hypoxemic patients to fly commercial airlines.

Effects of Pressure Changes

Air or gas trapped in body cavities expands in direct proportion to the decrease in pressure. For example, at 18,000 ft, the volume of trapped gas would be doubled. Sudden decompression of an aircraft flying at that altitude or higher would cause severe discomfort in all passengers but serious complications in patients who had undergone recent abdominal, thoracic, or eye surgery.

Changes in atmospheric pressure can result in dysbarism. This term refers to pathological disturbance of gas-containing cavities in the human body usually occurring because of a preexisting condition.

Aerotitis (or Barotitis) Media.—The primary cause is failure to ventilate the middle ear cavity properly through the Eustachian tube during transition from a relatively low atmospheric pressure to a relatively high atmospheric pressure. Unless air can enter the Eustachian tube during descent from a simulated altitude of 5,000 ft to sea level, a differential pressure on the tympanic membrane of 2.5 psi or 130 mm Hg will occur at ground level. This is sufficient to retract and immobilize the tympanic membrane. Symptoms are decreased hearing, discomfort in the ear, and sometimes tinnitus. The predisposing cause is inflammation of the nasopharyngeal orifice of the Eustachian tube, usually by a respiratory tract infection.

Recommendation: Patients should be advised not to fly during the congestive stages of an upper respiratory tract disease.

If air transport is necessary, relief may be obtained by shrinking the mucous membranes of the upper respiratory tract passages through the use of nose drops or spray before and during descent or by taking an oral decongestant (eg, pseudoephedrine hydrochloride) one hour before descent.

The patient should perform a modified Valsalva maneuver frequently during descent to promote patency of the Eustachian tube. Crying in small children also may promote insufflation of the middle ear cavity.

Barosinusitis.—The ostia of the sinuses are occluded by swollen mucous membrane, preventing air from entering the sinus to equalize pressure on descent. The result is a lower pressure within the sinus than the atmospheric pressure.

Recommendation: Avoid flying during an upper respiratory tract infection. Use shrinking agents orally or locally or both before and during descent.

Aeroembolism.—This is not a problem in commercial aviation, since escape of nitrogen from the blood is unlikely to occur at altitudes lower than 25,000 ft. Decompressions from 8,000 to 30,000 ft, if not lasting more than 12 s, have been demonstrated to be well tolerated.

A special circumstance that may be a serious threat to health is that of the vacationer who has been scuba diving earlier in the day and then wishes to fly home. He is at risk at any altitude above sea level, even though he has been careful not to exceed US Navy diving table limits. The diving has resulted in considerable nitrogen forced into the body fat tissues. Liberation rate from solution is satisfactory at sea level, but at relatively low cabin altitudes (eg, 5,000 ft), the increased rate may result in aeroembolism or "bends."

Recommendation: Persons intending to scuba dive should be advised to allow at least 12 hours between their last dive and boarding a commercial aircraft. This delay between diving and flying should be extended to 24 hours in instances where repeated deep diving is anticipated.

Aerodontalgia.—The expansion of trapped gas in defective fillings, apical abscesses, and possible carious teeth may cause toothache during ascent.

Recommendation: Regular dental examinations and good dental hygiene should be encouraged for all persons who travel frequently by air.

In-flight analgesics may be administered to relieve pain resulting from aerodontalgia.

Expansion of Gas in Hollow Viscera.—Gas expands 1.2 times between sea level and 5,000 ft and 1.5 times at 10,000 ft. Expansion of a pocket of gas in the duodenum or ileum may cause mild to severe discomfort or nausea and vomiting.

Theoretically, gas expansion could rupture a diseased viscus, especially if peptic or duodenal ulcers, colitis, diverticulitis, or recent abdominal surgery is present. A pneumothorax or congenital cyst of the lung may be complicated severely by a decrease in atmospheric pressure, causing compression of functional pulmonary tissue, mediastinal shift, and possible secondary changes in circulatory function.

Recommendation: Commercial air transport is contraindicated in patients with pneumothorax, congenital pulmonary anomalies, known diseases of the bowel, or trapped air in any other area of the body. Flying should be deferred for 14 days after urologic or gastrointestinal tract surgery.

Patients who have undergone a colostomy should wear a large colostomy bag during flight and should be warned of possible complications during ascent. Additionally, patients should be advised to carry an extra colostomy bag during their flight.

Travelers in Aircraft Encounter Physical Stress

Acceleration.—Linear acceleration during takeoff of commercial aircraft appears to cause no problems. Theoretically, a transient redistribution of the volume of circulating blood with pooling in the feet might be a problem for patients with coronary insufficiency.

Noise and Vibration.—These do not present a problem medically, but patients with cranial nerve VIII damage should obtain seats as far as possible from plane engines.

Low Humidity.—The air inside a plane has a low relative moisture content. However, insensible water loss is not a problem in adults during limited flights, and ingestion of 240 mL of water during the flight adequately restores any water loss. Children, who have a relatively greater body water content, and especially infants, may become dehydrated during a long flight.

Recommendation: Infants should be given water in frequent small amounts throughout the flight. If fed during descent, the sucking and swallowing mechanism may be helpful in ventilating the middle ear.

Turbulence.—Motion sickness probably is caused by linear vertical motion on the vestibular organ. Psychological factors may lower the individual threshold.

At a high cruising altitude, the degree of turbulence is minimal in large jet aircraft.

Recommendation: Patients susceptible to motion sickness should take an anti-motion sickness drug before flying. These are available as nonprescription cyclizine hydrochloride (Marezine), dimenhydrinate (Dramamine), and others.

Other measures to decrease motion sickness are flying at night to reduce visual stimulation, sitting in a reclining position, obtaining a seat as far from the engines as possible to decrease vibration, or occupying a seat toward the center of gravity of the plane.

Prolonged Immobilization.—Lack of muscle movement in the lower extremities may result in some pooling of blood in these areas with slight pedal edema. Venous stasis might be a problem in patients with cardiac insufficiency or preexisting thrombotic or venous disease with danger of a pulmonary embolism.

Recommendation: **The airlines suggest muscle-contracting exercises performed frequently while seated. Patients with varicosities should wear elastic stockings or other supportive devices as well as actively and frequently exercising the leg muscles.**

CONTRAINDICATION TO TRAVEL BY COMMERCIAL AIRCRAFT

Patients with emergency medical or surgical conditions who require immediate transportation generally should be carried by a well-equipped and staffed air or ground ambulance. Nonemergency patients with problems that may hinder their mobility (eg, body casts) may require a charter aircraft (air taxi). Wheelchair passengers generally may travel by air if able to accomplish transfer from seat to chair in-flight without requiring flight crew members to lift or move them physically. Aerostretchers are available on some airlines for patients in stable condition who must travel in a horizontal position. The flight surgeon of the individual airline should be contacted regarding the situation. A list of major medical contraindications to commercial air travel is presented as a guide for physician/patient consultation.

Cardiovascular: within (four) weeks after myocardial infarction (consultation with the airline flight surgeon is suggested for all travelers who recently have experienced myocardial infarction); within (two) weeks after cerebrovascular accident; severe hypertension; decompensated cardiovascular disease or any condition that restricts cardiac reserve (see also Table 3).

Bronchopulmonary: pneumothorax; congenital pulmonary cysts; vital capacity less than 50%.

Eye, ear, nose, and throat: recent eye surgery; acute sinusitis; acute otitis media; surgical mandibular fixation by permanent wiring of jaw (the device may be modified using rubber bands or rip cords to permit opening the mouth in case the patient vomits due to motion sickness).

Gastrointestinal tract: less than ten to 14 days after abdominal surgery; acute diverticulitis or ulcerative colitis; acute esophageal varices; acute gastroenteritis.

Neuropsychiatric: epilepsy (an epileptic may fly if well controlled medically and if flight does not exceed cabin altitude of 8,000 ft; the airline should be notified of passenger's condition before departure, and the passenger should be accompanied by a knowledgeable companion); prior events of violent or unpredictive behavior; recent skull fracture; brain tumor.

Hematologic: anemia with a hemoglobin level less than 8.5 g/dL or an RBC count of 3 million/cu mm (adult values); sickle cell disease (contraindicated for atmospheric altitudes above 22,500 ft; consult flight surgeon); hemophilia.

Table 3.—Altitude Limits for Cardiorespiratory Patients*

Limit, ft	Problem
10,000	Suspected or symptomatic cardiorespiratory disease
8,000	More than mildly symptomatic cardiorespiratory problems Marked ventilatory restriction
6,000	Myocardial infarction 6 to 24 weeks previously Angina pectoris Sickle cell anemia Cyanosis from any cause Cor pulmonale Respiratory acidosis
4,000	Severe cardiac disease with cyanosis or recent decompensation Any 2 of the following, concurrently: Cyanosis Cor pulmonale Respiratory acidosis
2,000	Congestive heart failure Myocardial infarction within last 6 wk Concurrent cyanosis, cor pulmonale, and respiratory acidosis

Without supplemental oxygen. Based on recommendations of the American College of Chest Physicians, from Welch. Table 3 is reproduced with permission from the *Journal of the American College of Emergency Physicians* (1977;6:156).

Pregnancy: beyond 240 days or threatened miscarriage.

Miscellaneous: patients requiring intravenous fluids; patients requiring special medical apparatus (defibrillators, suction machines, and so on; consult flight surgeon).

IN-FLIGHT EMERGENCIES

Physicians as passengers aboard a commercial aircraft may be requested to volunteer their services if a medical emergency arises. The general policy of airlines is triage of the problem by a cabin attendant with a report to the captain; request for physician's services, if necessary; and, if no physician is available, further request for a paramedic or trained nurse.

United States commercial airlines are classified as "common carriers" and are not legally obligated to attend to the health care needs of passengers aboard aircraft.

First aid training of cabin attendants varies among commercial airlines. According to several medical representatives from major airlines, flight attendant training in first aid ranges from four to 12 hours and may include cardiopulmonary resuscitation with annual refresher courses of one to six hours. The competence of the attendant is, of course, an individual matter.

The first aid kits aboard airplanes contain only basic bandages and do not contain any drugs except aspirin, acetaminophen, antiemetics, and possibly pseudoephedrine nasal sprays. The only instrument available is a flashlight. Oxygen is available if a physician decides it should be administered. Medical instruments are not carried on domestic flights, but foreign airlines may carry a complete emergency kit, including some drugs, on overseas flights.

The captain of every airliner can establish ground contact with an identified medical resource if requested. This resource may be at the airport or may be a flight surgeon in the airline's medical department. Therefore, a volunteer physician may obtain immediate consultation if necessary and may request a staffed and equipped ambulance at the flight's terminus (often provided by the major airport itself) and may alert a receiving hospital regarding the patient's condition.

A volunteer physician may request diversion of the flight to the nearest airport where runways are of sufficient length to accommodate the plane. Most airlines can reach such a terminal within 30 to 40 minutes (except on overseas flights). However, this decision should be considered carefully.

An unscheduled landing, which must be assigned priority over other traffic, disrupts the flow of air traffic at busy major airports, causing a "ripple effect" on many other aircraft airborne in the area. The traveling public is subjected to the inconvenience and costliness of disrupted flight schedules. While unscheduled landings usually can be made safely, such landings are costly (thousands of dollars) to the airline concerned, especially if the landing requires dumping thousands of gallons of fuel to permit landing within weight limits. Flights should be allowed to proceed unless the passenger's life is threatened or intolerable discomfort cannot be alleviated by the resources at hand.

COMMON MEDICAL PROBLEMS ENCOUNTERED IN-FLIGHT

Hyperventilation is the most common medical complication encountered during commercial flights. Because of complex symptoms, hyperventilation is often misdiagnosed as respiratory distress or coronary heart disease. The classic picture of tetany with paresthesia and a markedly increased respiratory rate is unusual. Hyperventilation usually occurs because of anxiety about flying and is rarely the result of organic causes.

The following is a list of common medical problems that may confront the physician on a commercial aircraft. Each problem is accompanied by suggestions for treatment that reflect the limited availability of medical resources on commercial flights.

Hyperventilation: establish breathing into an oxygen mask that is not connected to an oxygen supply; establish breathing into a paper bag (emesis bag).

Fainting: lower head and raise legs; administer oxygen if needed.

Barotitis or sinusitis: use nasal decongestant before and during descent; swallow, yawn, or perform Valsalva maneuver.

Asthma: administer oxygen; relocate passenger in no smoking section.

Myocardial infarction: administer oxygen; request diversion of flight to nearest appropriate medical resource; request ambulance to meet plane and notify local hospital of arrival.

Angina: administer oxygen; administer nitroglycerin if available; request diversion of flight to nearest medical resource only if relief of symptoms is not possible.

Epileptic seizure: clear airway; insert gag between teeth (eg, handkerchief roll); administer oxygen until seizure stops.

Chronic obstructive lung disease: administer oxygen; may request that aircraft descend to 22,500 ft (sea level cabin altitude) if oxygen appears ineffective.

Abdominal pains: rule out organic causes; if severe pains persist, advise flight crew of problem and request descent to lower altitude.

PHYSICIAN'S PERSONAL IN-FLIGHT MEDICAL KIT

Since the airlines kit contains no potent drugs or diagnostic equipment, some physicians may wish to carry a small first-aid kit in-flight. Physicians who elect to carry a medical kit should include in it only those true emergency drugs and instruments that they feel competent to use. Following is a suggested list of basic drugs and equipment that may be considered for inclusion in a physician's personal kit: stethoscope (aircraft noise severely masks heart sounds); oropharyngeal airways, adult and child sizes; small flashlight with extra batteries; tongue blades; anaeroid sphygmomanometer (optional—convenient but not highly accurate at high altitudes); small bandage scissors.

Drugs in ampuls or preloaded syringes: epinephrine hydrochloride; lidocaine hydrochloride; diazepam (Valium, oral and injectable); atropine sulfate; nitroglycerin (fresh); an injectable antihistamine (diphenhydramine hydrochloride); pseudoephedrine or nasal decongestant spray or both; an analgesic (pentazocine or codeine); glucagon hydrochloride (optional).

CONSULTATIONS WITH MEDICAL DEPARTMENTS OF COMMERCIAL AIRLINES

If a patient requires a special diet during his flight, the local reservation office of the specific airline should be contacted at least 24 hours before departure. In instances where a flight will involve a change in time zones, the patient should be reminded of the need to adjust drug or dietary schedules that have been prescribed on a time regimen.

Physicians caring for patients who will need special attention while flying should provide these patients with written instructions on the treatment that will be required during the flight and an explanation of any arrangements that have been made with the airline medical department for special equipment or services. The patient should be advised to deliver the written instructions to the flight attendant on boarding the airplane. To discuss the transportation of patients with special problems, a physician may request consultation with a company physician by calling the local reservation office of the specific airline.

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AC NO: 121-24

DATE: 6/23/77

ADVISORY CIRCULAR

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

SUBJECT: PASSENGER SAFETY INFORMATION BRIEFING AND BRIEFING CARDS

1. PURPOSE. This Advisory Circular contains information and guidance material for use by air carriers in the preparation of passenger safety information briefings. The information listed herein includes those items required by regulations, as well as items considered to be desirable passenger information. The goal is to facilitate standardization and improvement of the safety information presented to passengers by the airline industry.

2. REFERENCE. Federal Aviation Regulations 121.311, 121.317, 121.333, 121.571, 121.573, 121.577, 121.589.

3. BACKGROUND. Past investigations of accidents and incidents have shown that many passengers were unaware of safety information that would have helped them in an emergency. The basic methods of informing passengers about safety information are the pretakeoff oral briefing and the passenger information card. Since experience has indicated that many passengers do not pay attention to the oral briefings and do not always read or understand the briefing cards, they should be as appealing and interesting as possible to obtain passenger interest. Such information should be concise and accurate. Present oral briefings have been generally standardized. However, a review of passenger briefing cards shows a wide variance in the quality of cards and the methods used to portray this supplementary information. This Advisory Circular lists items that should be covered in a briefing or on an information card plus other items that are generally covered to add support to the oral briefings. While some air carriers are using pictorial means to convey the information, any means of pictures or words, or a combination thereof, is acceptable as long as the information is presented in a clear and concise manner.

Initiated by: AFS-220

4. ORAL BRIEFING.

a. Pretakeoff.

(1) As required by FAR 121.571, 121.577 and 121.589, the minimum information to be presented in the pretakeoff briefing is the smoking rule, the location of emergency exits, tray tables and seatbacks in the full upright position and the requirement that carry-on baggage (located at passenger seats) be properly stowed in the underseat retainers for takeoff and landing. Instructions on the fastening, tightening and unfastening of seatbelts should be given.

(2) When required by FAR 121.333(f), the briefing includes the location and use of the oxygen system. The demonstration of the oxygen mask should include instructions on the need to extinguish smoking materials, how to initiate oxygen flow, the placement of the mask on the face, adjustment of the elastic strap on the head and the tightening of the strap ends to hold mask on the face. Passengers should be given information concerning the need for immediate donning of the dropped mask, the amount of inflation of the oxygen reservoir bag (where applicable) and the necessity to keep the oxygen mask on their faces until they are told to remove it by a crewmember. Additional instructions and warnings (on initial generation time lapse, heating of individual canisters, etc.) should be included for oxygen systems that utilize the individual self-generating units.

(3) The pretakeoff oral briefing has been successfully and satisfactorily transferred to a video presentation by at least one carrier. This method of passenger briefing should be considered when the aircraft has the necessary video and sound equipment. The advantages of a video tape presentation are the assurance that a complete briefing is given, that the diction is good and an overall high quality of briefing is maintained. It also lends itself very well to bilingual presentations when necessary.

b. Post Takeoff. The post takeoff briefing required by FAR 121.571(a)(2) includes announcements to the passengers concerning smoking and seatbelts. After the no smoking sign is turned off, they should be advised where the smoking rows or zones are located and that smoking in the lavatories is prohibited. Although not regulatory, a statement should be made at this time to refrain from smoking while standing or walking in the aisles. Just before or immediately after the seatbelt sign is turned off, an additional announcement should be made to keep seatbelts fastened while seated even though the seatbelt sign is off. (Note: This announcement will have a better impact on passengers if made by the captain.)

c. Prelanding. The minimum prelanding briefing (normally given immediately after the captain turns on the seatbelt/no smoking sign) includes

those items required by FAR's 121.577 and 121.589, namely, the requirements for tray tables and seatbacks to be in the full upright position, seatbelts fastened securely, smoking materials extinguished and carry-on baggage stowed in the underseat retainer for landing.

d. Post Landing. The minimum post landing briefing should advise passengers to remain seated with seatbelts fastened until the aircraft is parked at the gate and the engines have been shut down. This request should be accompanied by an explanation that any sudden unanticipated stop could cause physical harm to passengers standing up to retrieve overhead articles. It is desirable to give a signal to the passengers, such as turning the seatbelt sign off, when it is safe to move about.

e. Crewmember Procedures. Each oral briefing presented by a carrier for its passengers should be fully explained and described in the appropriate company manual.

5. PASSENGER SAFETY INFORMATION CARD.

a. General. The oral briefings listed above should be supplemented by a printed card, as required by FAR 121.571, with instructions and diagrams as necessary, to aid the passenger in the use of emergency equipment. The cards may utilize any method of diagrams, photos, written messages, etc., to impart the message, but the message must be clear and concise. The use of symbology to eliminate the need for printed instructions on the card has worked well for many carriers. It has particularly good application on flag carriers who are faced with the necessity of briefing in one or more foreign languages. Special instructions should be added when an emergency system is new and any detail of its use is uniquely different from past systems used by air carriers. A card should be developed that is pertinent to only one specific type and model of aircraft.

b. Content. The passenger safety information card should display the information described in paragraph 5.c. On extended overwater flights, the information in paragraph 5.d. should also be displayed. The primary method of presentation should be pictorial. When the term "instruction" is used in this Advisory Circular, it refers only to the information presented to passengers by the passenger safety information card. As required by FAR 121.571, the information on the card must refer only to the type and model airplane used for that flight.

c. Minimum Presentation Requirements - Overland Flights.

(1) Emergency Exits. FAR 121.571 requires diagrams and methods of operating emergency exits. Location of these exits should also be included. Past experience has indicated that confusion is sometimes created by a diagram or picture that demonstrates operation of an emergency door

peculiar to only one side of the aircraft. If, for instance, all emergency door handles rotate toward the rear of the aircraft, an explanation on the card should expand on the diagram to explain this item to the passengers. Routes from passenger areas to exits (based on full passenger load, known exit evacuation rates and use of all emergency exits) should be depicted.

(2) Evacuation Slides. Operation and use of slides should be shown. If slides are not automatic, the manual mode inflation procedure should be included. Any special warnings about exit routes once outside the aircraft (e.g., on a wing or at the foot of a slide) should be depicted.

(3) Oxygen.

(a) Diagrams should, when use of oxygen is required by FAR 121.333, supplement the oral briefing and demonstration on the use of oxygen systems. It should be made clear that the bag on the oxygen mask (where applicable) is to be used as an indication of the flow of oxygen. The relationship of aircraft altitude to the amount of oxygen bag inflation should be indicated. Some warning against smoking in the vicinity of oxygen flow should be indicated on the card.

(b) The passenger safety information card should illustrate that passengers must (1) immediately pull the mask firmly toward their faces, so as to assure that the lanyard attached to the mask releases the activating pin (if applicable); (2) place the mask on their face (covering BOTH nose and mouth); and (3) adjust the elastic strap over the head.

(4) Seatbelts. Due to the variation in types of seatbelts and past incidents wherein passengers have not known how to use their seatbelts, it is desirable to supplement the oral briefing with illustrations showing the fastening, tightening and unfastening of the seatbelt.

(5) Brace Positions. Proper brace-for-impact positions should be shown for all seat orientations; i.e., forward and rearward. Diagrams should show positions that are realistic and are physically attainable considering the seating configuration in the aircraft described on the passenger briefing card.

(6) Individual Flotation Devices. As required by FAR 121.573, information on the location and use of individual flotation devices (if used) must be provided. Instructions on how to remove the flotation devices and use them in water should be given. The specific stowed location of flotation vests should be indicated. Instructions should be provided on removal from stowage locations, donning, using the manual and oral inflation systems and operation of survivor lights where manual operation of such lights is required.

d. Additional Presentation Requirements - Extended Overwater Flights.

(1) Passenger Exit Awareness and Location. Passengers should be instructed on the most appropriate exit for their use. Determination of the most appropriate exits should consider a full passenger load, the number and capacity of liferafts or slide/rafts to be launched from each exit, position of passengers to each ditching exit and the use of all exits that have been planned for liferaft/slide launchings.

(2) Life Preservers. As required by FAR 121.573, the specific location(s) where life preservers are stowed must be provided. Instructions on removal from the stowage location(s), donning, using manual and oral inflation systems and manual operation of survivor locator lights and accessories, as appropriate, should be provided.

(3) Liferafts and Slide/Rafts. Instructions on liferaft retrieval, preparation for use, inflation methods, launching locations and how to secure to the aircraft should be given. Stowage locations and methods of inflating slide/rafts, methods of boarding and detaching liferafts or slide/rafts should be depicted.

(4) Emergency Locator Transmitters and Survival Equipment. If portable emergency locator transmitters and/or auxiliary survival equipment is required by FAR 121.353, instructions must be provided on their locations and methods of retrieval.

6. BRIEFING OF HANDICAPPED PASSENGERS. As required by FAR 121.571, a flight attendant will conduct an individual pretakeoff oral briefing of each passenger who, in an emergency, may need the assistance of another person to evacuate. If this person is accompanied by an attendant, the attendant should also be briefed. The briefing should cover:

a. Routes to each appropriate exit; and

b. The most appropriate time to begin moving to an exit.

R. P. SKULLY
Director, Flight Standards Service

U.S. Department of Transportation
Federal Aviation Administration

Advisory Circular

Subject:	Date:	7/29/86	AC No:	25-9
SMOKE DETECTION, PENETRATION, AND EVACUATION TESTS AND RELATED FLIGHT MANUAL EMERGENCY PROCEDURES	Initiated by:	ANM-110	Change:	

1. PURPOSE. This advisory circular (AC) provides guidelines for the conduct of certification tests relating to smoke detection, penetration, and evacuation, and to evaluate related Airplane Flight Manual (AFM) procedures. These guidelines may be used to reduce the degree of subjective judgment needed in conducting tests and evaluating test results. While this AC is not mandatory, it offers a method of demonstrating compliance with the applicable airworthiness requirements.

2. RELATED FEDERAL AVIATION REGULATION (FAR) SECTIONS. The related sections are §§ 25.831, 25.855, 25.857, 25.858, 25.1301, 25.1309, 25.1359, 25.1585(a) and 121.308 of the FAR.

3. BACKGROUND. The development of standardized test procedures was initiated in 1975 to eliminate subjective evaluations of the smoke detection, penetration and evacuation procedures used in demonstrating compliance with the applicable sections of Part 25. Though the flammability characteristics of the interior cabin materials have been reduced since that time, these materials may emit potentially lethal smoke and toxic gases when they are exposed to sufficient heat or are involved in the combustion process. Due to these concerns, and a National Transportation Safety Board (NTSB) recommendation, these guidelines have been developed.

4. SUBJECTS AND DEFINITIONS. For purposes of this AC, the following are applicable:

a. Smoke. Smoke consists of aerosols (e.g., carbon particles), gases, fumes and vapors that are the result of pyrolysis or the combustion process.

b. Smoke Classification. It is difficult to classify smoke and standardize smoke test procedures because smoke characteristics and composition vary with the materials and processes that create smoke. Visual perception of objects, when viewed through smoke, varies with the wavelength of light used to illuminate the smoke or to measure smoke density. For these reasons, the wavelength of light used to establish transmissibility and smoke type should be selected to standardize the smoke test result if precise and repeatable results are desired.

c. Vapors or Fogs. Protection from vapors or fogs created by atomized fluids leaking from glycol or hydraulic systems are beyond the scope of

this AC; however, prudent design practices, e.g., shrouding and drains, should be used to reduce exposure to these substances.

d. Buoyancy and Stratification. Buoyancy and stratification of smoke vary with the substance from which the smoke is generated and the environmental conditions in which it is generated. A smoke generator that uses tobacco as the fuel will produce smoke that is more buoyant (initially) than the cooler smoke produced from a theatrical type smoke generator. Although stratification can occur with either type of smoke, theatrical type smoke generators will generally fill a compartment from the floor up. Theatrical type smoke is buoyant enough that some mixing will take place from the natural turbulence in the compartment even though the smoke distribution may not be uniform. On the other hand, the more buoyant smoke from a tobacco type generator remains more stratified. During one test with tobacco smoke, it was observed that the smoke did not reach the floor for the duration of the test. This is one of the reasons the theatrical type smoke is recommended for smoke penetration tests. The less buoyant theatrical type smoke may not be useful for detection tests because it may not adequately represent the buoyant properties of smoke that may be generated from the typical smoke sources found in the compartments being tested.

e. Smoke Sources and Duration (Continuous Smoke Source).

(1) Reasonably probable sources of smoke include fires caused by cigarettes, incendiary or explosive devices, cargo fires, and failures of electrical and pneumatic equipment. Fluid leaks or spills, e.g., hydraulic, glycol, etc., in combination with heat or ignition sources may also produce hazardous quantities of smoke.

(2) Incidents of fire or smoke that cannot be extinguished continue to occur. Smoke and fire procedures should, therefore, be formulated considering that the fire or smoke exposure may be continuous. Smoke from fires in cargo or equipment located in inaccessible locations should be considered to be continuous, in particular. Continuous smoke from equipment bays, equipment cooling systems, the cockpit, and cargo compartments should be considered reasonably probable because these compartments have so many potential sources of smoke or have a history of fire or smoke occurrences.

(3) Failures that cause fire and smoke should be included in the failure assessment conducted under §§ 25.831, 25.1309 and 25.1359. It should be determined, for each failure condition considered for this assessment, whether smoke detectors and specific fire or smoke procedures are warranted and whether the failure or secondary effects should be prevented through the use of isolation, containment, extinguishers, etc. The likelihood of a continuous exposure to smoke may be based on a failure evaluation which would include the sources of failure, contributing materials, failure preventative measures and smoke control or containment means. The adequacy of the smoke control and the containment means should be verified by smoke tests.

f. Smoke Toxicity.

(1) A failure condition may create smoke at a continuous or variable rate and may occur at any time during a flight. Because the composition of the smoke would vary with the available oxygen, heat produced, and the type of materials pyrolized or consumed, the exposure duration and concentrations are unpredictable. Furthermore, human tolerance to typical airplane fire toxicants has not been adequately defined. For these reasons, a failure evaluation using a qualitative approach and smoke toxicity limits used to define a hazardous quantity of smoke is not practical. The practical approach is to prevent exposure to the smoke.

(2) Measuring concentrations of toxic or hazardous gases, such as carbon monoxide (CO), carbon dioxide (CO_2) and extinguishing agents is beyond the scope of this AC.

g. Material Flammability Characteristics. The flammability characteristics of interior cabin materials, electric wire insulation and hydraulic fluids have been improved; however, these materials will still emit smoke and combustion gases when exposed to sufficient heat or burned. Hydraulic fluids are considered flammable fluids, and glycol mixtures may also be flammable fluids depending on the concentration of water mixed with the glycol. The use of less flammable materials does not preclude the need to consider these materials as sources of smoke.

h. Airplane Modifications. Airplane modifications that may require smoke tests include the alteration of, addition to or removal of, pneumatic systems (bleed air, air conditioning, pressurization, ducting and distribution, equipment cooling, etc.), baggage or cargo compartments, interiors, interior seals, cockpit panels, etc. Each modification must be evaluated on its own merit. The assessment should consider all modifications, including those behind or between panels or between panels and the fuselage skin.

5. AIRPLANE FLIGHT MANUAL (AFM) FIRE AND SMOKE PROCEDURES.

a. Section 25.1585(a) specifies that emergency procedures for airplane fires must be furnished in the AFM. These procedures generally require the flightcrew to communicate the emergency, don protective breathing equipment, shut off ventilation to cargo compartments and recirculation systems, or increase the ventilation to occupied areas, or to use a combination of these procedures. Operational procedures also generally require flight attendants to communicate the nature and status of the emergency, don protective breathing equipment, attempt to extinguish the fire and perform other related emergency functions. Emergency procedures should be evaluated during the design review and smoke tests to determine that the optimum procedures have been selected.

b. Section 25.831 allows the use of depressurization within safe limits to evacuate smoke from the cockpit. Depressurization reduces the density of smoke by evacuation and may increase the ventilation air flow. This procedure is not, however, a final solution and should be considered

only an interim means to control a fire until further action can be taken. The degree of depressurization used as a procedure for smoke evacuation should not result in automatic deployment of passenger oxygen masks. Decompression, whether intentional or the result of a fire related failure, may activate certain types of smoke detectors. Unless a detector that is not effected by decompression is installed, the emergency procedures and methods of distinguishing between these two conditions should be formulated and furnished in the AFM.

c. The AFM fire and smoke emergency procedures should include instructions for the flightcrew to immediately proceed to the nearest suitable airport when fire or smoke is detected. If it can be visually verified that the fire has been extinguished and a damage assessment indicates it is safe to do so, the flight may be continued. This verification and assessment should be accomplished by a flight crewmembers' observation of the fire or smoke source and not by reliance on observations of smoke or detectors. Flightcrews may be misled into thinking a fire is extinguished or under control when it is not. For example, diminishing smoke due to smoke evacuation procedures, fire detector failure or saturation, fire related containment or ventilation failures, or the use of extinguishing systems may cause loss of the detector warning or cause diminishing smoke even though the fire may not be extinguished.

d. Fire control in Class C cargo or baggage compartments is usually maintained by staggered discharge of multiple built-in extinguisher bottles. If an explosion occurs in the cargo or baggage compartment, the liner should be assumed to be ruptured. The smoke detector should, in turn, be considered unreliable due to possible damage or ventilation changes caused by loss of the integrity of the liner. Due to the possible loss of fire containment and detection capability following an explosion, the recommended procedure should be to discharge the extinguisher bottles as a precautionary measure if visual inspection of cargo or baggage compartments is not possible and to land at the nearest suitable airport.

6. SMOKE TESTS.

a. Test methods. There are three smoke tests associated with the certification process; smoke detector tests, smoke penetration tests and smoke evacuation tests. Either the visual observation method or the instrumented method may be used to conduct these tests.

(1) The Visual Observation Method. The visual observation method uses the subjective judgment of an FAA observer to make determinations as to the adequacy of the smoke tests and test results.

(2) The Instrumented Method.

(i) The instrumented method uses photosensitive instruments to measure light transmissibility through smoke. These measurements are compared to acceptable criteria in lieu of using an FAA observer's judgment. Judgment has not been completely eliminated, however, because the acceptability of the tests must still be determined.

(ii) The source light for measuring transmissibility should be a laser of wavelength 632.8 nanometers. The use of a longer wavelength is better for measuring particle density and is not affected as much by light scatter or reflection and ambient light as a light source of shorter wavelength.

(iii) Theatrical smoke, which is a cool white smoke, should be used for the penetration and evacuation tests. Theatrical smoke may not represent the darker smoke associated with burning fuel or synthetic materials; however, it is less objectionable and is buoyant enough for penetration test purposes. The use of theatrical smoke may not provide realistic detection times if detectors are mounted in the ceiling.

(iv) The instrumented method provides acceptable standards to measure the transmissibility of light through smoke. This method should eliminate the need for any subjective judgment in evaluating the test results. In the event a different smoke type is used or a light source with a different wavelength is used, it will be necessary to establish new transmissibility values.

b. Airplane Flight Test Conditions. Except as noted for the lavatory smoke detector tests, the test conditions should be selected as follows:

(1) Flight Tests. The configuration of the cabin air conditioning and pressurization systems should represent any normal operating condition and any other conditions in which the airplane may be dispatched. The test conditions should represent the flight conditions that are the most critical with respect to smoke detection, penetration and evacuation. These would include tests conducted during climb, cruise, descent, or approach flight conditions under maximum and minimum pressure differentials and under maximum and minimum ventilation flow rates.

(2) Ground Lavatory Smoke Detector Test. The airplane should be operated to simulate the ventilation airflow of the various dispatchable ventilation and pressurization configurations (one air conditioning pack, two air conditioning packs, etc.) for the cruise condition. Some airplanes may be designed with a lavatory vent that may be either closed or open on the ground. For such airplanes, a flight test should be conducted or the lavatory vent system should be temporarily reconfigured to simulate the flight condition.

c. Smoke Flight Testing Hazards. Conducting smoke tests can be hazardous because they are designed to simulate hazardous conditions. Caution is therefore warranted. A test site and time should be selected with the concurrence of Air Traffic Control. Air Traffic Control should also be informed of the type of test and that the test airplane may be operating under restricted cockpit visibility. This will facilitate, if necessary, the routing of other air traffic away from the test airplane.

d. Test Limitations.

(1) The tests described have been developed primarily for large cargo or baggage compartments, equipment bays, equipment cooling systems, galleys and lavatories that are accessible in flight. Modifications of the test procedures or equipment may be needed to validate a test procedure for compartments or cooling systems which are not accessible in flight. The effect that the smoke generator itself has on the test should be considered for small compartments or cooling systems.

(2) The results of these tests are valid only if the airplane is maintained in the condition and configuration that was tested, i.e., the integrity of the compartment, including any seals and liners, is maintained, and the ventilation systems and extinguishing systems are in working order. It is assumed for test purposes, unless a failure condition is being simulated, that a fire would not damage or destroy the integrity of the ventilation system or the compartment.

7. SMOKE DETECTOR INSTALLATION TESTS.

a. Background.

(1) The purpose of a smoke or fire detector is to provide a warning before the situation escalates to an uncontrollable or uncontainable condition. The detection must be as early as possible to assure that the methods or procedures used to contain or control a fire or smoke are effective. In this regard, the fire must be detected early enough to prevent damage to the wiring or equipment that is necessary for safe flight and penetration of liners, shrouds or tubing carrying flammable fluids. The fire must be detected at temperatures significantly below that at which the structural integrity of the airplane is substantially decreased.

(2) A smoldering fire producing a small amount of smoke in conjunction with a one minute detection time was selected as a fire or failure condition that could be detected early enough to assure that the fire and smoke procedures would be effective. Subjective judgment, considering the failure, size of compartment, materials contained in the compartment, and the containment methods and procedures, is needed to assess the significance of a small amount of smoke.

(3) Theatrical type smoke generators produce smoke at rates necessary for smoke penetration tests but in excess of those necessary for detection tests. These smoke generators are capable of simulating smoke from a vigorous fire which may be capable of destroying an airplane, a fire that should be detected long before it reaches that level of hazard. The cool smoke produced by a theatrical smoke generator may be unacceptable for ceiling mounted detectors because of its lack of buoyancy. Furthermore, smoke particles generated from typical materials found in cargo compartments will be filtered (particles stick to the inside walls of the tubes) in long smoke detector tubing runs. Theatrical smoke does not demonstrate any significant sticking effect. For these reasons, theatrical type smoke generators should not be used for detection tests.

b. Objective. The smoke detection test is designed to demonstrate that the smoke detector installation will detect a smoldering fire producing a small amount of smoke.

c. Limitations. Typical smoke detectors have inherent limitations. For example, they may cease to operate due to internal failures, fire related damage or smoke saturation. Certain smoke detectors may also provide a fire warning when decompression occurs. Due to these inherent limitations, it should not be assumed that a fire is out, when the indication ceases.

d. Test Equipment. The smoke generating equipment used for detector tests should simulate a smoldering fire which produces only a small amount of smoke. Materials that represent the fuel for the probable source of smoke may be burned in a container that is covered with a metal screen. For safety, a fire extinguisher and a metal container lid should be provided. A Beekeeper type smoke generator may be used when some restraint is placed on the quantity of smoke being generated. A pipe or cigar may be a suitable source of smoke for a closet or lavatory size compartment.

e. Test Procedure.

(1) The smoke should be generated at a location that is critical with respect to the detector's area of coverage. For the lavatory smoke detection test, the smoke source should be located at the most probable source, e.g., the trash receptacle.

(2) The smoke generator should produce only a small amount of smoke in order to simulate a smoldering fire.

(3) The smoke detection should occur within one minute after the start of smoke generation.

(4) The method of smoke generation and the time to detect the smoke should be recorded. Pictures are useful means of recording the test and test apparatus.

8. SMOKE PENETRATION TESTS.

a. Background.

(1) The purpose of smoke penetration tests is to demonstrate that smoke will not enter occupied areas of the airplane from cargo or baggage compartments, equipment bays, or equipment cooling systems containing large quantities of smoke. The definition of a "large quantity" of smoke is associated with the rate of smoke generation and the volume it must fill. A large quantity is achieved when the compartment is filled and kept filled by continuously generating smoke.

(2) Except as noted in paragraph e(1)(v) below, any penetration of smoke into occupied compartments from cargo compartments, equipment bays or equipment cooling systems during the tests is unacceptable because the toxicity of the smoke is unpredictable and in an actual situation, the smoke exposure might continue or increase to a hazardous level before a landing can be made. The smoke concentrations and exposure time in an actual fire or smoke situation might be well beyond those demonstrated during the limited duration of the smoke penetration tests. Generally, any smoke penetration during the tests demonstrates that the smoke containment means or control methods are unacceptable.

(3) Generally, the theatrical type generators produce smoke at an adequate rate for smoke penetration tests. Certain models of this type generator may not be adequate, however, for some of the larger cargo compartments. It may, therefore, be necessary to move the generator around the compartment, conduct several tests or use multiple generators.

b. Objective. The objective of this test is to demonstrate that a large quantity of smoke generated in a cargo or baggage compartment will not penetrate into any occupied compartment. This test also demonstrates that a large quantity of smoke generated in equipment bays or cooling systems will not penetrate into the passenger cabin, and if any smoke penetrates into the cockpit, it can be readily removed using the AFM emergency fire and smoke procedures.

c. Limitations. Successful completion of the smoke penetration tests does not relieve the requirement to conduct carbon dioxide, carbon monoxide, and extinguisher tests in complying with §§ 25.831(c), 25.851 and 25.855.

d. Equipment.

(1) The Visual Observation Method.

(i) A smoke generator that has the capability to fill the compartment being tested with smoke and keep it filled for the duration of the test should be selected. To save flight test time, it should be verified on the ground that the generator can continuously produce large quantities of smoke in the compartment being tested. The criteria of paragraph 8e(1)(iii) should be met with the airplane pressurization and ventilation systems operated to approximate the airflow for the test condition being simulated.

(ii) The smoke generator should not produce smoke that is noxious, corrosive, or toxic and should be capable of immediate shutdown if a hazardous condition develops. Portable protective breathing equipment, with spare bottles, should be provided for test personnel.

(2) The Instrumented Method.

(i) The Smoke Generator. The same equipment as specified in paragraph 8d(1) should be used.

(ii) Light Transmissibility Measuring Device. The light transmissibility should be measured through smoke along a three foot light path using a calibrated photoelectric cell and a laser that produces light with a wavelength of 632.8 nanometers. The light path may be folded provided each path through the smoke is no less than 18 inches. The calibration of the light transmissibility measuring device should be checked by using "Wratten" filters as outlined in National Bureau of Standards Information Report (NBSIR) 77, dated June 1977, (reference paragraph 11b) or any other acceptable calibration procedure.

e. Test Procedure.

(1) The Visual Observation Method.

(i) The smoke generator(s) should be placed to generate smoke in the Class B, C, D, or E cargo or baggage compartment, the equipment cooling system or the equipment compartment in the position most likely to result in penetration of smoke into occupied areas of the airplane. All compartment lights should be on.

(ii) Large quantities of smoke should be generated continuously. The AFM fire and smoke emergency procedures should be initiated no less than 30 seconds after detection.

(iii) The smoke should be generated continuously at a constant rate for at least 5 minutes after detection for compartments or equipment cooling systems containing smoke detectors. For those compartments that do not contain smoke detectors, e.g., Class D cargo or baggage compartments, smoke should be generated for 5 minutes. The compartment should be filled with smoke at the end of the 5 minute period. In this regard, the compartment is considered filled with smoke when an FAA observer, from anywhere in the compartment, cannot see his/her hand when it is held approximately 18 inches in front of his/her face unless the hand is silhouetted by a window or interior light.

(iv) Smoke generation should be continued for an additional 15 minutes if the criteria of paragraph 8e(1)(iii) are not achieved or unless it is apparent (e.g., from results of previous tests within the compartment) at any point in time after an additional 5 minutes that further smoke generation will not produce penetration in occupied areas.

(v) The FAA observer in the occupied compartment should verify that smoke does not penetrate occupied compartments. Except as noted below, the formation of a light haze indicates that the ventilation requirements of § 25.831(b) are not being met.

(A) Wisps of smoke that enter and immediately exit at the occupied compartment boundaries are acceptable as long as a light haze or stratified haze does not form. If this condition (i.e., wisps of smoke at the compartment boundary) occurs, the test procedure or paragraph 8e(1)(iv) should be followed.

(B) Crewmembers must be able to extinguish fires in Class B cargo or baggage compartments. This means that the crewmember must pass through the cargo or baggage compartment smoke barrier or access door at least once. The crewmember entering or exiting the compartment may disturb the normal airflow and cause some smoke to enter the passenger or flightcrew compartment. This is acceptable if the smoke that enters the passenger or flightcrew compartment is dissipated rapidly.

(C) Open or closed loop equipment cooling systems and equipment bays may interface with the cockpit systems. When penetration tests are conducted in the equipment bay or in the cooling system, a small amount of smoke may penetrate the cockpit. That smoke should dissipate quickly when the AFM smoke and fire procedures are used.

(vi) If the smoke generator(s) do not completely fill and keep the cargo or baggage compartment filled with smoke, additional tests should be conducted with the generator(s) relocated as necessary to provide adequate coverage.

(vii) Section 25.855(e)(3) requires that smoke should not be detected in any adjacent compartment. Smoke penetration tests are conducted in partial compliance with § 25.855(e)(3) (the last paragraph). Full compliance is shown when all smoke tests and extinguisher tests are completed successfully. The same criteria would apply when smoke detectors or extinguishing systems are installed in equipment bays or cooling systems to comply with § 25.831(c) or § 25.1309(c).

(2) The Instrumented Method. The procedures used for this method are the same as those shown in paragraph 8e(1) for the visual observation method except that the following are substituted for paragraph 8e(1)(v):

(i) Light transmissibility readings should be taken in the occupied area at seated head height level (4 feet above the floor) and at least 18 inches from the partition between the occupied compartment and the compartment in which the smoke is being generated.

(ii) If visible smoke is present in the occupied compartment, the reading should be taken at a number of points between the armrest and standing head height level (6 feet above the floor), and at least 18 inches away from the partition between the occupied compartment and the compartment in which the smoke is being generated.

(iii) The transmissibility level in any occupied compartment should not be less at any time during the test than it was before the start of the smoke tests, i.e., zero plus any prevailing atmospheric reduction in transmissibility.

(iv) The exceptions in paragraph 8e(1)(v) are also applicable to instrumented tests.

9. SMOKE EVACUATION TESTS.

a. Background.

(1) Cockpit smoke evacuation tests verify that smoke, from sources within the cockpit, can be readily evacuated in accordance with § 25.831(d). Typical commercial transport airplanes are capable of evacuating dense cockpit smoke within approximately a minute and a half after the AFM fire and smoke emergency procedures are initiated. Three minutes is the maximum acceptable time to evacuate smoke from any transport category airplanes.

(2) The ventilation of main deck lavatories or galleys may not be isolated from that of the passenger compartments. As smoke evacuation tests are not required for the passenger compartments, they are not required for such lavatories and galleys.

(3) Many galleys and lavatories currently being installed on large transport airplanes are designed with independent exhaust systems. The primary function of these exhaust systems is to ventilate and remove odors from these facilities; however, they also remove locally generated smoke. Smoke tests are useful as a means to verify that such exhaust systems are functioning properly in accordance with § 25.1301.

b. Objective. The objective of the in-flight smoke evacuation test is to demonstrate that the AFM emergency fire and smoke procedures provide means to clear the cockpit of dense smoke at an acceptable rate. This test should also demonstrate that the flightcrew can use the procedures without introducing any additional hazard.

c. Test Equipment. The same equipment as used in smoke penetration tests may be used in smoke evacuation tests (see paragraph 8d(1)).

d. Limitations.

(1) Some airplane designs have automatic cockpit or instrument light dimming features to reduce light intensity for night flight. Smoke may cause the automatic dimming feature to function, thus making instrument visibility more difficult. A manual means to override the dimming control should be provided for each dimming circuit. There should be a procedure that specifies that the light or instrument intensity be turned up, as necessary, when smoke is present in the cockpit.

(2) If it is determined that the autoflight systems must be used during the smoke evacuation tests, then their use should be incorporated into the AFM emergency procedures. An alternative should also be developed because a failed autoflight system could be the cause of the smoke in the cockpit. In this regard, there may also be phases of flight, e.g., takeoff, landing or decompression in which the use of the autoflight system may be prohibited when smoke is in the cockpit.

e. Test Procedures. The smoke evacuation tests should be conducted with smoke generated within the compartments as follows:

(1) Cockpit.

(i) The cockpit door or curtain, if installed, should be closed for the test. The crew should don protective breathing equipment as soon as the smoke is evident.

(ii) When the cockpit instruments are obscured (standard dial indicator numbers or letters become indiscernible), smoke generation should be terminated, and the appropriate AFM fire and smoke procedures should be initiated. The smoke should be reduced within three minutes such that any residual smoke (haze) does not distract the flightcrew nor interfere with operations under Instrument Flight Rules (IFR) or Visual Flight Rules (VFR).

(2) Galleys With a Dedicated Exhaust System. If a galley door or curtain is provided, it should be closed, and enough smoke should be generated to verify that smoke dissipation or smoke flow is toward the galley exhaust system. Airplane flight manual galley fire and smoke procedures should be demonstrated at this time.

(3) Lavatories With a Dedicated Exhaust System. The lavatory door or curtain should be closed, and enough smoke should be generated to verify that smoked dissipation or flow is toward the lavatory exhaust system. Airplane flight manual fire and smoke procedures should be demonstrated at this time.

10. SMOKE TEST EQUIPMENT.

a. Typical Smoke Generation Equipment for Detection Testing.

(1) Generators. An appropriate generator should be selected, e.g.:

(a) A metal container with a metal cover screen and lid;
(b) A pipe or cigar;
(c) A Woodsman Bee Smoker; or
(d) Any other acceptable device.

(2) Fuel. Representative materials should be selected, e.g.:

(a) Plastics;
(b) Rags;
(c) Tobacco;
(d) Burlap;
(e) Paper; or
(f) Any other acceptable representative material, etc.

b. Typical Smoke Generation Equipment for Penetration and Evacuation Tests.

(1) Generators, e.g.:

(a) Cloudmaker Model 11-48 (B, D);

(b) Farnum Barn Fogger;
(c) Pepper Fog;
(d) Cloud Nine (Superseded by Maxi-Mist);
(e) Maxi-Mist;
(f) Mini-Mist (Suitable for small compartments); or
(g) Any other acceptable device.

(2) Fuels. Use the fuel recommended by the smoke generator manufacturer, e.g.:

(a) Silicon Oil;
(b) Paraffin Oil;
(c) Mineral Oil; or
(d) Propolene Glycol or water solutions of propolene glycol or glycol.

c. Test Equipment for the Instrumented Method for Penetration Tests.

(1) Light Source. Helium Neon Laser Tube outputting light at a wavelength of 632.8 nanometers, Manufactured by CW Radiation Co., A Division of Aerotech, 101 Zeta Drive, Pittsburgh, PA 15238.

(2) Photo (Light) Detector. Model UDT 161. Manufactured by United Detector Technology, 3939 Landmark Street, Culver City, CA 90232.

(3) Smoke Generator. Cloudmaker 11-48. Supplied by Testing Machines, Inc., 400 Bayview Ave., Amityville, NY 11701.

(4) Fuel. Paraffin Oil or Mineral Oil.

11. REFERENCES.

a. "Fire Detector Response in Airplane Application" by Steve J. Wiersma and Robert G. McKee of the Fire Research Department, SRI International, Menlo Park, California. This article was published in the August/September, 1978 issue of Aviation and was based on a SRI International report by N.J. Alvares and R.G. McKee titled, "The response of Smoke Detectors to Pyrolysis and Combustion Products from Airplane Interior Materials," prepared for NASA under contract NAS2-8538. Reference was also made in this article to "Fire Detection Devices," Aviation Engineering and Maintenance, November/December, 1977.

b. National Bureau of Standards Information Report NBSIR-77 titled "Instruction Manual for NBS Photometric Smoke Measurement System" by Richard W. Bukowski, from the Center for Fire Research, Institute for Applied Technology, National Bureau of Standards, Washington, D.C. 20234.

LEROY A. KEITH
Manager, Aircraft Certification Division

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 121

[Docket No. 24792; Notice No. 85-17]

Protective Breathing Equipment

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Notice of proposed rulemaking (NPRM).

SUMMARY: This notice proposes to update the regulations concerning protective breathing equipment (PBE) by: (1) Incorporating the airplane certification requirements applicable to PBE in § 25.1439 of the Federal Aviation Regulations (FAR) into § 121.337, the operating rule requiring PBE applicable to air carriers and commercial operators who operate aircraft having a passenger seating configuration, excluding any pilot seat, of more than 30 seats or a payload capacity of more than 7,500 pounds; (2) incorporating the standards for PBE in Technical Standards Order-C99 (TSO–C99) into § 121.337 by reference; (3) requiring that PBE must allow interphone communications from each of two flight crewmember stations in the pilot compartment to at least one normal flight attendant station in each passenger compartment; (4) requiring the performance by Part 121 crewmembers of an approved firefighting drill using PBE; (5) requiring that additional PBE determined by airplane passenger seating configuration be easily accessible and conveniently located within 3 feet of each required hand fire extinguisher in passenger compartments of airplanes operated under Part 121; and (6) clarifying certain current emergency drill requirements. This action was prompted by recommendations of the National Transportation Safety Board (NTSB) which found during an accident investigation that smoke goggles forming a part of certain PBE used by several air carriers did not adequately protect the flightcrew and that some goggles restricted the user's vision and their ability to carry out their duties in an emergency.

DATE: Comments must be received on or before February 10, 1986.

ADDRESSES: Send comments on the proposal in duplicate to: Federal Aviation Administration, Office of the Chief Counsel, Attention: Rules Docket (AGC–204), Docket No. 24792, 800 Independence Avenue, SW., Washington, D.C. 20591. One may deliver comments in duplicate to: FAA Rules Docket, Room 916, 800 Independence Ave., SW., Washington, D.C. 20591. All comments must be marked "Docket No. 24792." Comments may be examined in the Rules Docket weekdays, except Federal holidays, between 8:30 a.m. and 5 p.m.

FOR FURTHER INFORMATION CONTACT: Mr. Roger Riviere, Project Development Branch, AFO–240, Air Transportation Division, Office of Flight Operations, Federal Aviation Administration, 800 Independence Avenue, SW., Washington, D.C. 20591, Telephone (202) 426–8096.

SUPPLEMENTARY INFORMATION:

Comments Invited

Interested persons are invited to participate in this rulemaking by submitting written data, views, or arguments and by commenting on the possible environmental, energy, or economic impact of this proposal. The comments should identify the regulatory docket or notice number and be submitted in duplicate to the address above. All comments received, as well as a report summarizing any substantive public contact with FAA personnel on this rulemaking, will be filed in the docket. The docket is available for public inspection both before and after the closing date for making comments.

Before taking any final action on the proposal, the Administrator will consider any comments made on or before the closing date for comments. The proposal may be changed in light of comments received.

The FAA will acknowledge receipt of a comment if the commenter submits with the comment a self-addressed, stamped postcard on which the following statement is made: "Comments to Docket No. 24792." When the comment is received, the postcard will be dated, time stamped, and returned to the commenter.

Availability of NPRM

Any person may obtain a copy of this notice of proposed rulemaking by submitting a request to the Federal Aviation Administration, Office of Public Affairs, Attention: Public Inquiry Center, APA–430, 800 Independence Avenue, SW., Washington, D.C. 20591, or by calling (202)426–8058. Requests should be identified by the docket number of this proposed rule. Persons interested in being placed on a mailing list for future proposed rules should also request a copy of Advisory Circular No. 11–2A, Notice of Proposed Rulemaking Distribution System, which describes the application procedure.

Background

Protective breathing equipment (PBE) consists of a full face mask attached to an oxygen supply or a face mask, including smoke goggles, attached to an oxygen supply. Rules requiring operators conducting air carrier operations outside of the United States to have such equipment installed in their aircraft were originally included in § 41.24(c) of the Civil Air Regulations (CAR), which became effective on October 21, 1949. The basic requirements of the early standards were that the equipment be designed to prevent the person wearing the equipment from breathing noxious gases. Such standards were also a part of the type certification basis for older aircraft, and they still are applicable.

Subsequent amendments to the transport category airplane type certification requirements resulted in the current PBE requirements set forth in § 25.1439 of the FAR. That rule specifies the airplane compartment configurations for which PBE is required, establishes performance standards for the equipment, and specifies the oxygen supply requirements for such equipment. Under the rule, PBE is required in an airplane if there are cargo compartments or isolated separate compartments, including upper and lower lobe galleys, into which the flightcrew may enter during flight. Performance requirements in this rule specify that PBE must be designed to protect the flightcrew from smoke, carbon dioxide, and other harmful gases; that the PBE must also include suitable covering for eyes, nose, and mouth; and that a specified amount of oxygen must be supplied.

On July 11, 1973, a Boeing 707 (B–707) airplane made a forced landing short of the runway at Paris, France, as the result of a cabin fire started by a cigarette in a rear lavatory waste bin. Intense fire, smoke, and poisonous gases spread throughout the aircraft, with the result that only 11 of the 134 occupants survived the landing. Investigation indicated that the use of upgraded PBE meeting the revised standards contained in TSO–C99 could have permitted these flight attendants using such upgraded equipment to extinguish the fire in flight and thus might have saved more lives.

On November 3, 1973, a fatal accident occurred in Boston, Massachusetts, involving a B–707 freighter airplane. Investigation of this accident prompted the NTSB to evaluate PBE used by a number of air carriers. The NTSB reported that smoke goggles used by several air carriers did not adequately protect crewmembers from smoke and

that certain smoke goggles in use appreciable restricted the wearer's vision. The NTSB recommended that all transport category aircraft, regardless of date of certification, be required to comply with current § 25.1439 and that all smoke goggles presently in use be inspected to ensure that they comply with § 25.1439.

On June 2, 1983, an in-flight fire occurred in the aft lavatory in the passenger compartment of a Douglas DC-9 airplane en route to Montreal, Canada. The crew was unable to control the fire and requested an emergency descent and air traffic control clearance to the nearest available airport. The crew successfully landed the airplane at Covington, Kentucky. Soon after passenger and crewmember egress from the airplane commenced, dense smoke rapidly spread through the passenger compartment, apparently making it impossible for 23 of the 41 passengers on board to find their way to emergency exits. The FAA's analysis of this accident results in the conclusion that a number of those passengers who perished might have survived if certain cabin safety improvements under consideration at that time by this agency had been adopted. One of those improvements is the proposal contained in this rulemaking which would require additional PBE for use by crewmembers in passenger compartments of airplanes. It is conceivable that, had the airplane been equipped with the additional PBE proposed by this notice, the use of the additional PBE by the flight attendants involved could have aided them in leading more of the passengers who perished to available exits for egress from the airplane.

On October 31, 1983, the NTSB issued two safety recommendations pertinent to this rulemaking. Safety Recommendation A-83-74 recommends that the FAA "require that protective breathing equipment, including smoke goggles, currently carried aboard transport category airplanes to comply with 14 CFR 25.1439 and 14 CFR 121.337 which do not meet the minimum performance standard prescribed in Technical Standard Order (TSO) C99 or equivalent be replaced with equipment which meets the standards." Safety Recommendation A-83-75 recommends that the FAA "amend 14 CFR 121.337 to prescribe a minimum number of portable protective breathing apparatus with full face masks which will be carried in the passenger compartment of transport category airplanes readily accessible to cabin attendants and flightdeck crew." The FAA, for the most part, agrees with these two NTSB safety recommendations and, except for rulemaking currently under consideration to upgrade § 25.1439, has incorporated them into the proposals to follow in this notice.

The current requirement (§ 121.337) for PBE used by Part 121 operators provides that the flightcrew be protected from smoke, carbon dioxide, and other harmful gases. However, that requirement provides too general an operational standard for the FAA to guage compliance. The requirement for "protection" is actually composed of several different criteria, of which the most significant is the amount of contamination that can be tolerated by the eyes and lungs without unduly impairing a crewmember's vision or breathing.

The FAA conducted a survey of reports concerning human physiological limitations resulting from 15-minute exposures to contaminants likely to be present in aircraft fires. The results of this survey show that contaminant concentrations in the air of 5 percent for breathing and 10 percent for eye contact are the maximum acceptable levels for 15 minutes of exposure to crewmembers. These standards are currently incorporated in material referenced in TSO-C99.

Using these concentration levels as standards of performance, the FAA tested a number of oxygen mask-smoke goggle combinations. The tests showed that many of these PBE units permitted in excess of the 5 and 10 percent contaminant concentration levels.

In general, minimum performance standards established by the FAA are issued in the form of TSO's. Until recently, TSO's were included within the Federal Aviation Regulations (Part 37); they are now issued as nonregulatory material but continue to provide a basis for approval of materials, parts, and appliances. Minimum standards for PBE were just recently developed and are contained in TSO-C99. The FAA proposes to incorporate this TSO by reference in § 121.337, and compliance with its standards will thereby be made mandatory. The Office of the Federal Register will be requested to approve this incorporation by reference before any final rule is issued as a result of this NPRM. TSO-C99 incorporates by reference the Society of Automotive Engineers (SAE) Aerospace Standard (AS) 8031, "Personal Protective Devices for Toxic and Irritating Atmospheres, Air Transport Crew Members," dated June 1980. SAE AS 8031 incorporates by reference SAE AS 452A, "Oxygen Mask Assembly, Demand and Pressure Breathing, Crew," dated October 20, 1965. Copies of SAE AS 8031 and AS 452A may be purchased from the Society of Automotive Engineers, Inc., Department 331, 400 Commonwealth Drive, Warrendale, PA 15096. A copy of TSO-C99 may be reviewed at any FAA Regional Office and Engineering and Manufacturing District Office. Requests for a copy of TSO-C99 may be sent to the Federal Aviation Administration, ATTN: Ms. Bobbie Smith, AWS-110, 800 Independence Avenue, SW., Washington, D.C. 20591.

In addition to proposing that the standards of TSO-C99 and § 25.1439 be incorporated in the operating rule, § 121.337, the FAA is proposing that PBE be required in several locations in aircraft operated under Part 121; that an approved firefighting drill using PBE be performed by all crewmembers; that additional PBE be installed in aircraft operated under Part 121; that, for passenger compartments, PBE be easily accessible and conveniently located within 3 feet of each hand fire extinguisher required by 14 CFR 121.309; and that certain emergency drill requirements in Part 121 be clarified. These proposals result from accidents mentioned previously where smoke and noxious gases may have impaired crewmembers when fighting cabin fires and when assisting passengers to evacuate the aircraft and, as previously noted, NTSB recommendations A-83-74 and A-83-75, which state that a minimum number of PBE units should be prescribed to be carried aboard transport category aircraft and that PBE carried aboard those aircraft should be required to comply with §§ 25.1439 and 121.337 and TSO-C99.

As a result of studies and recommendations, the FAA recently adopted rules that will result in the addition of fire-blocking layers in aircraft seat cushions, smoke detectors in lavatories and galleys, and additional and improved fire extinguishers in aircraft operated under Part 121, in addition to those items proposed in this notice.

The FAA has carefully evaluated the cost and benefits to this proposal and has concluded that the lives saved are in addition to any lives that have previously been accounted for in other cabin safety initiatives.

The benefits of the PBE proposal are those lives saved and injuries prevented by improved crewmember visual and respiratory protection and active crewmember firefighting response in a potentially catastrophic in-flight fire. In contrast, the benefits of related FAA cabin safety initiatives are those lives

saved and injuries prevented by passive fire protection countermeasures in both in-flight and post-crash fires. Smoke detection devices, fire retardant materials, and improved passenger egression measures are passive in nature and independent of crewmember activation. The PBE proposal enhances the effectiveness of passive fire protection initiatives by providing an active countermeasure against the hazards of in-flight fires. With respect to this, the benefits attributed to the proposal represent an increase in the savings to the general public above the cost of lives and injuries already cited in other related FAA initiatives.

Discussion of the Proposed Rule

Section 121.337(a)

The FAA proposes to combine the existing requirements of § 121.337, the minimum standards to TSO–C99, and the standards of § 25.1439 into a revised § 121.337 and make air carriers and commercial operators who conduct operations under the operating rules of Part 121 responsible for meeting these requirements.

At present, most of the PBE requirements are contained in the aircraft certification rule, § 25.1439. That rule specifies equipment requirements for PBE designed to protect crewmembers while fighting fires on aircraft in accessible compartments. Standards for PBE are found in TSO–C99, which is not a part of the FAR. The FAA proposes to combine the equipment requirements of § 25.1439 and the standards of TSO–C99 by incorporating that document by reference in a revised operating rule, § 121.337. This would consolidate the requirements now found in several regulations and TSO–C99.

Section 121.337 (b), (c), and (d)

These sections would combine certain requirements now contained in § 121.337 and selected portions of § 25.1439.

Proposed § 121.337(b) would combine the requirements now found in § 121.337(a) concerning pressurized cabin airplanes with PBE requirements in § 25.1439 (b)(1) through (b)(6).

Proposed § 121.337(b)(4) would require that PBE, while in use, must allow the flightcrew to use the radio equipment and to communicate with each other while at their assigned duty stations. The proposal would add a new requirement that the equipment must also allow interphone communications from each of two flight crewmember stations in the pilot compartment to at least one normal flight attendant station in each passenger compartment. This requirement is necessary in those instances where the flightcrew needs prompt information concerning the efficacy of firefighting actions or smoke elimination procedures to determine the proper course of action to take if a passenger compartment fire cannot be readily extinguished or smoke in the passenger compartment cannot be readily removed.

Proposed § 121.337(b)(7) would require that PBE with a fixed or portable oxygen supply must be conveniently located in the cockpit and be easily accessible for immediate use by each required flight crewmember at his/her assigned duty station. Since some older aircraft do not have the built-in ducting for a fixed oxygen supply, the FAA is proposing a new requirement to provide for PBE with a portable oxygen supply to be used at each flight crewmember duty station.

Proposed § 121.337(b)(8) (i) through (iv) would consist of the requirements currently specified in § 25.1439(a) plus several additional requirements.

Proposed § 121.337(b)(8)(i) would require that one PBE with a portable oxygen supply be located for use in each Class A, B, and E cargo compartment (as defined in § 25.857) that is accessible to crewmembers during flight. Proposed § 121.337(b)(8)(ii) would require that one PBE with a portable oxygen supply must be provided in each upper and lower lobe galley for each crewmember expected to be in these areas during any operation. Proposed § 121.337(b)(8)(iii) would require that one additional PBE with a portable oxygen supply must be provided on the flight deck. Proposed § 121.337(b)(8)(iv) would require that each PBE with a portable oxygen supply for use in the passenger compartment must be easily accessible and conveniently located within 3 feet of each hand fire extinguisher required by § 121.309. Locating the PBE and hand fire extinguisher within 3 feet of each other would provide crewmembers with easy access to both items of equipment should an emergency arise.

A proposed new § 121.337(e)(1) would be added to provide that each item of PBE having a fixed oxygen supply must be checked and determined to be operating properly before each flight crewmember who might use the equipment takes off in that aircraft for his/her first flight of the day. The PBE must be checked by the flight crewmember who will use the equipment to ensure that the equipment is functioning, fits properly, and is connected to appropriate oxygen supply terminals and that the oxygen supply and pressure are adequate for its use.

A proposed new § 121.337(e)(2) would be added to require that each item of PBE located at other than flight crewmember duty stations and having a portable oxygen supply must be checked by the responsible crewmember and determined to be operating properly before he/she takes off in that aircraft for the first flight of the day. The PBE must be checked by the crewmember designated by the certificate holder in its operations manual to ensure that the equipment is properly stowed and serviceable and that the oxygen supply is fully charged.

Concerning PBE located at flight crewmember duty stations having either a fixed or portable oxygen supply, each flight crewmember must check that the PBE is functioning properly by turning on the oxygen supply and checking for proper oxygen flow in the mask and related equipment. Each flight crewmember must check his/her PBE at his/her duty station for proper fit. Concerning PBE having a portable oxygen supply that is located at other than flight crewmember duty stations, crewmembers must check to see that the PBE is properly stowed, ensure that it is serviceable by checking the mask visually, and establish, by checking the oxygen tank gauge, that the oxygen pressure is adequate for its use.

Proposed § 121.337(b) would also require that, after a date 1 year after the effective date of this proposed amendment, no person may operate a transport category airplane unless PBE meeting the requirements of proposed § 121.337 is provided for flight crewmember use. The 1-year period is intended to allow certificate holders lead time to schedule the aircraft modifications necessary for compliance to coincide with major maintenance inspections and to develop appropriate maintenance and crewmember procedures and instructions. The FAA specifically requests comments on the adequacy of this 1-year implementation period.

Section 121.417

Proposed § 121.417(c) would be amended by reorganizing current § 121.417(c) to clarify and specify that certain emergency drills are required to be "performed" by crewmembers and that certain other emergency drills are required to at least be "observed" by crewmembers. Additionally, current § 121.417(c) would be reorganized to clarify and specify which emergency drills are to be accomplished at different points in time (drill periods). The first drill period is delineated in proposed § 121.417(c)(1). Under that proposal,

one-time emergency drills would be required to be accomplished during initial training. The second drill period is delineated in proposed § 121.417(c)(2). Under that proposal, additional, different emergency drills would be required to be accomplished during initial training and once each 24 calendar months during recurrent training. Proposed § 121.417(c) would delete from current § 121.417(c) the term "participate in" and add the term "observe" in its place. Proposed § 121.417(c) would clarify and specify the requirement in current § 121.417(c) that each crewmember must accomplish certain emergency training drills using those items of installed emergency equipment for each type of aircraft in which he/she is to serve.

Proposed § 121.417(f) would, for the purposes of this section, add definitions for "perform" and "observe." "Perform" would mean accomplishing a prescribed emergency drill using established procedures involved in the drill, and "observe" would mean to watch without participating actively in the drill.

Proposed § 121.417(c)(1)(i) contains a new one-time emergency drill requirement that would be performed during initial training. This requirement provides that a crewmember must perform at least one approved firefighting drill using at least one type of installed hand fire extinguisher, appropriate for the type of fire to be fought, while using the type of installed PBE required by § 121.337. The hand fire extinguisher and PBE would be required to be of the types carried aboard the airplanes on which the crewmember is to serve.

The purpose of this training is to acquaint each crewmember with one of the types of firefighting equipment available on the airplanes on which he or she will be serving, how to activate that equipment, and how the fire retardant reacts with a fire. Additionally, this drill is a confidence builder that permits those being trained to wear and use the equipment while fighting a fire and to gain confidence that the equipment could be used effectively in a real-life emergency situation.

If the proposal in this notice is adopted as a final rule, the FAA will publish an advisory circular or Air Carrier Operations Bulletin describing one method of accomplishing an approved firefighting drill.

Proposed § 121.417(c)(1)(ii) is based on the current requirements in § 121.417(c) and (c)(4). The proposal clarifies the current requirements that the performance of the emergency evacuation drill, including the use of a slide, is a one-time emergency drill requirement for all crewmembers and is to be performed during the initial training period delineated in proposed § 121.417(c) described above. The proposal specifically provides that each crewmember must perform an emergency evacuation drill, with each person egressing the aircraft or approved training device using at least one type of installed emergency evacuation slide. The crewmember may either observe the aircraft exits being opened in the emergency mode and the associated slide/raft pack being deployed and inflated, or perform the tasks resulting in the accomplishment of these actions.

Proposed § 121.417(c)(2) is the same as current § 121.417(c), which requires that each crewmember must perform additional emergency drill requirements during initial training and once each 24 calendar months during recurrent training.

Proposed §§ 121.417(c)(2)(i)(A) through (D) are the same as current §§ 121.417(c) (1) through (3) and (5), respectively, with two exceptions. Proposed § 121.417(c)(2)(i)(B) would require operation of installed hand fire extinguishers while current § 121.417(c)(2) requires the operation of each type of fire extinguisher. Proposed § 121.337(c)(2)(i)(C) would clarify the emergency drill requirement in current § 121.417(c)(3) pertaining to each type of emergency oxygen system to include PBE.

Proposed §§ 121.417(c)(2)(i)(E) through (E)(6) are the same as current §§ 121.417(c)(6), (6) (i), (ii), (iii), (iv), (viii), and (ix), respectively. However, proposed §§ 121.417(c)(2)(ii)(A) would add the words "if applicable" to the language of current § 121.417(c)(6)(v) to indicate that the drill would be required to be accomplished if the certificate holder engages in extended overwater operations without holding a deviation authorizing extended overwater operations without the emergency equipment required by § 121.339 of this part.

Proposed §§ 121.417(c)(2)(ii), A through D, are the same as current §§ 121.417(c)(6)(v), (vi), and (vii) and (c)(4), respectively, except for use of the new term "observe" rather than the deleted term "participate in" discussed above. The proposal would make it clear that crewmembers would be permitted to observe the drills specified in those paragraphs rather than having to participate in them during the initial and recurrent training periods delineated in proposed § 121.417(c)(2) described above.

Proposed § 121.417(d) is a new provision which would require, in pertinent part, that 1 year after the effective date of the proposed rule, no crewmember may serve in operations under this part unless the crewmember has performed the firefighting drill prescribed by § 121.417(c)(1)(i).

Regulatory Evaluation

This section summarizes the preliminary industry cost impact and benefit assessment of an NPRM to amend Part 121 of the FAR to upgrade the level of protection for the traveling public against the hazards of in-flight fires. The NPRM proposes to adopt new standards for PBE and to establish the operating certificate holder as the party responsible for providing PBE. The NPRM also proposes to adopt new and more stringent firefighting training requirements for all crewmembers.

The NPRM, in part, is a result of a recommendation by the NTSB which found during an accident investigation that PBE (smoke goggles) used by several air carriers did not adequately protect the flightcrew and that some smoke goggles restricted the user's vision. The action to increase crewmembers' firefighting training was prompted by the FAA's awareness of several fatal in-flight fires in aircraft of U.S. manufacture operated by foreign carriers and by the alarming number of cabin fire and smoke-in-the-cabin incidents recorded in recent years.

The methods and assumptions used in this analysis to prepare cost and benefit estimates for the proposed changes to §§ 121.337 and 121.417 have been developed by the FAA. The estimates of economic impacts for the NPRM changes to the PBE and fire training requirements have been constructed from unit cost and other data obtained from air carriers, industry trade associations, and manufacturers and are based on the best information available to the FAA. These estimates are subject to change before the close of the public comment period if better information becomes available.

The present value of the PBE proposal cost, including the cost of maintenance and installation, is estimated to be approximately $25.5 million. The present value of the total cost of requiring that Part 121 crewmembers perform at least one approved firefighting drill has been estimated to be $35.5 million.

Benefits of the PBE and firefighting training proposal will be the prevention of potential fatalities, injuries, and property damage resulting from fires originating in the flight deck and in other areas in the passenger cabin.

Quantification of these benefits is made difficult by the relatively limited number of in-flight cabin fire accidents. No major cabin fire accidents have occurred in U.S. air carrier passenger operations. During the last 10 years, only three major in-flight fires have occurred in worldwide operations in which the proposed countermeasures may have been effective in averting an accident. When such accidents have occurred, however, the results have been catastrophic. To allow for the uncertainty inherent in predicting future accidents when historical data are limited, a risk analysis has been performed. The risk analysis generates a probability distribution of the potential benefits which may be realized from accidents avoided as a result of the proposed amendments.

A comparison of the probability distribution of potential benefits and estimated costs of each proposal is summarized in Tables 1 and 2. Averages of the possible benefit and benefit/cost ratio outcomes weighed by the probability of each outcome, are also indicated as the expected benefit/cost ratio for each proposal. All values have been discounted at the 10 percent discount rate prescribed by the Office of Management and Budget over the 10-year period of this analysis.

For the purpose of this analysis, the FAA has calculated the cost of additional time required for crewmember firefighting training on the basis of an assumed average additional 3 hours of compensable time per trainee. This has been done to account only for the assumed additional time imposed by regulation and to compensate for the minority of air carriers that currently have firefighting training and will not incur a cost as a result of this proposal. More detailed information is needed regarding additional labor and operating costs imposed by the new firefighting requirements on air carriers for the evaluation of any final rule that may result from this proposal. Therefore, the FAA solicits data, views, etc., relating to the economic impact of the proposed amendments to § 121.417. Specific comments regarding § 121.417 are requested as follows:

1. Cost estimates of the additional time and labor hours required to comply with the rule.
2. Estimates of cost associated with additional materials and facilities to comply with the new requirements.
3. Names of carriers currently conducting firefighting training.
4. Number and type of crewmembers currently receiving firefighting training.
5. Frequency and location of firefighting training.
6. Types of combustibles used in firefighting training.
7. Current crewmember training activities which may be displaced to accommodate firefighting training programs at no additional cost to the carrier.
8. Suggestions pertaining to alternative methods of accomplishing the objectives of the proposal (to increase protection against the hazards of in-flight fires for the traveling public).

The proposed amendments will have a significant economic impact on a substantial number of small entities. Therefore, an initial regulatory flexibility analysis has been included in the regulatory evaluation.

TABLE 1.—PROBABILITY DISTRIBUTION OF BENEFIT/COST RATIOS FOR PROTECTIVE BREATHING EQUIPMENT (PBE)

Benefit (millions)	Benefit/cost ratio	Probability[1] (in percent)
0	0	100
$9.4	.35	75
$18.0	.68	50
$25.5 (breakeven)	1.0	31
$28.6	1.1	25
$85.9	3.2	0

[1] That the Protective Breathing Equipment Proposal Will Equal or Exceed the Benefit/Cost Ratio the Benefit/Cost Ratio Shown at Left.

Note.—Expected Benefit/Cost Ratio=.84 (based on expected benefit of $21.5 million). Cost of Protective Breathing Equipment for 1985–1994—$25.5 million.

As shown above, using FAA standard economic values, there is a 25 percent probability that the benefits of the rule will exceed its costs. The expected benefit/cost ratio of .84 is based on an expected benefit of $21.5 million. However, the benefit value of $21.5 million is influenced by the value assigned to a life saved. The FAA value of a statistical life used in the evaluation was $650,000. There is much controversy over the value of a statistical life. For example, M.J. Bailey[1] has a range of estimates from $37,500 to $4,500,000. It is useful to examine the potential benefit that would result when a higher estimate of cost per life saved is applied. If a value in excess of $790,000 is assigned as the value of a statistical life, the expected benefits of the rule will exceed its costs.

TABLE 2.—PROBABILITY DISTRIBUTION OF BENEFIT/COST RATIOS FOR FIREFIGHTING TRAINING

Benefit (millions)	Benefit/cost ratio	Probability[1] (in percent)
0	0	100
$17.5	.49	75
$33.4	.94	50
$35.5 (breakeven)	1.0	46
$58.5	1.6	25
$133.6	3.7	0

[1] That the Firefighting Training Proposal Will Equal or Exceed the Benefit/Cost Ratio Shown at Left.

Note.—Expected Benefit/Cost Ratio=1.1 (based on expected benefit of $39.3 million). Cost of Firefighting Training for 1985–1994—$35.5 million.

[1] *Reducing Risks to Life, Measurement of the Benefits*, M.J. Bailey, American Enterprise Institute, Studies in Government Regulation, 1980, Washington, D.C.

Regulatory Flexibility Determination

The FAA has determined that under the criteria of the Regulatory Flexibility Act (RFA) of 1980, the amendment to §§ 121.337 and 121.417 proposed in this NPRM will have a significant economic impact on a substantial number of small entities. The RFA requires agencies to specifically review rules which may have a "significant economic impact on a substantial number of small entities." The FAA has recently adopted criteria and guidelines[2] for rulemaking officials to apply when determining if a proposed rule has a significant economic impact on a substantial number of small entities and guidance for the conduct of regulatory flexibility analysis and reviews.

Small Entities Affected

The proposed amendments to both § 121.337 and § 121.417 affect small air carriers which are regulated by Part 121 and operate aircraft having more than 30 passenger seats or a payload capacity of more than 7,500 pounds. The FAA order prescribing small entity size standards identifies a small air carrier as one with nine or fewer operating aircraft. According to FAA data for the period ended July 1, 1984, there were 47 air carriers subject to the rules of Part 121 that operated 9 aircraft or fewer. These 47 carriers are the small entities affected by the proposed rules in this NPRM.

Analysis of Economic Impact on Small Carriers

The FAA's thresholds for significant economic impact vary according to the equipment type operated and the kind of service provided. The annualized cost threshold for scheduled carriers is $47,506 or $85,070 depending on whether the fleet operated includes aircraft having 60 or fewer seats. However, the threshold for nonscheduled air carriers is only $3,314. The average impact for cost imposed by the proposed

[2] U.S. Department of Transportation, FAA Order 2100.14

amendments to § 121.337 is estimated by multiplying the average number (4) of aircraft per carrier by the aggregate cost of equipping one aircraft with the PBE required by the proposal. The cost of equipping one aircraft with PBE is estimated to be $5,730. Therefore, the average impact in the first year of the regulation on scheduled carriers would be ($5,730 × 4) $22,920 which is below the threshold established for air carriers. On the other hand, the equipping of one aircraft at an estimated cost of $5,730, for the first year the rule is in effect, will exceed the $3,314 threshold for unscheduled carriers. Thus, all affected small unscheduled carriers will incur a significant economic impact as a result of the proposed amendment to § 121.337.

The cost impact of the proposed amendment to § 121.417 is derived by multiplying the total cost of training one crewmember times the assumed number of flight-deck and cabin personnel of a small carrier operating four aircraft. The FAA assumes the average number of flight-deck and cabin personnel for a passenger air carrier with 4 airplanes is 44 persons. Flight-deck personnel are assumed to be 30 and flight attendants 14. The cost to train flight-deck personnel is (30 × $652) $19,560 and the cost to train cabin attendants is (14 × $132) $1,848. Therefore, the average impact the first year is $21,408, which exceeds the $3,314 annualized threshold for small unscheduled carriers. Thus, all unscheduled carriers will incur a significant economic impact as a result of the proposed amendment to § 121.417. This number exceeds ⅓ of the 47 affected small entities, which FAA has determined to be a substantial number. Thus, the proposed rule at implementation will have a significant economic impact on a substantial number of small entities. Therefore, in accordance with the terms of the RFA a regulatory flexibility analysis is required.

Initial Regulatory Flexibility Analysis

In keeping with the requirements of sections 603 (b) and (c) of the RFA, the following analysis examines the proposed rule and its effect on small entities.

Reasons for Agency Action

The intent of the NPRM is to increase the level of safety to the traveling public by ensuring that crewmember performance and flight safety are not impaired by the presence in the aircraft of smoke and other toxic byproducts of in-flight fires. The NPRM requires that PBE standards be improved and that each crewmember receive initial training in fighting a fire. These higher standards are required for safety since most current PBE have been found not to provide a safe level of eye and respiratory protection and most crewmembers are not trained in fire-fighting techniques.

Objectives of and Legal Basis of the Rule

The objective of the NPRM is to provide an increased margin of safety against the hazards of in-flight fires. The objective of the proposals is discussed in detail in the preamble to this NPRM.

The legal basis of the proposal is sections 313(a), and 601 through 610 of the Federal Aviation Act of 1958, as amended (49 U.S.C. 1354(a) and 1421 through 1430); 49 U.S.C. 106(g) (Revised, Pub. L. 97-449, January 12, 1983); 14 CFR 11.45.

Description of Affected Small Entities

The entities affected are Part 121 certificate holders operating nine or fewer aircraft. These entities are discussed in detail above.

Requirements for Compliance With the Rule

The NPRM requires compliance with the proposed amendments 1 year after the effective date of implementation of the rule. Compliance involves equipping each aircraft with PBE that will meet the minimum performance standards of TSO-C99 and requiring that each crewmember undergo firefighting training while wearing an approved PBE during initial emergency training.

Overlap of the Rule With Other Federal Rules

There are no other Federal rules which duplicate, overlap or conflict with the proposal.

Alternatives to the Proposals

Section 121.337—Protective Breathing Equipment

Alternative 1. Require that only flight-deck PBE be modified to meet TSO-C99 standards.

This alternative would eliminate the requirement that PBE be located within 3 feet of every fire extinguisher location required by § 121.309 and would result in considerable savings to small carriers. Flight-deck PBE, both fixed oxygen supply and one portable unit, would be available to the flight-deck crew. The portable unit would enable a first officer or flight engineer to fight a fire in another location of the airplane.

On the negative side, portable PBE would not be available to cabin attendants to assist them in performing tasks critical to the protection of passengers in the presence of in-flight fires.

This alternative is rejected because it denies passengers the margin of additional safety against the hazards of in-flight fires provided by flight attendant personnel.

Alternative 2. Require a 3-year compliance period for small air carriers.

This alternative would lessen the immediate economic impact of the proposal which requires compliance with the rule 1 year from the effective date of its implementation. The protracted compliance period would enable small carriers more easily to absorb the cost of compliance because PBE can be gradually purchased over a 3-year span.

Against this alternative, the public which uses the services of small air carriers has a right to a level of safety equal to that afforded travelers using large air carriers. In this same context, some passengers may have no choice but to use the smaller carriers.

This alternative is rejected because all members of the traveling public should be equally protected against the hazards of in-flight fires, and the proposal is required for the safety of the general public.

Section 121.337—Crewmember Emergency Training

Alternative 1. Require only that small air carrier flight deck crewmembers be required to undergo firefighting training to satisfy the requirements of the rule.

This alternative would save small carriers the compliance cost of having to train their flight attendant personnel.

On the negative side, cabin attendants would not benefit from the training which is intended to increase the entire crew's level of firefighting proficiency and thus enhance safety.

This alternative is rejected because recurrent training in actual firefighting procedures is the most effective means of maintaining crewmember proficiency against the hazards of in-flight fires.

Alternative 2. Require that only cabin attendant personnel be trained in firefighting procedures.

This alternative would save small carriers the cost of training flight-deck personnel and may potentially result in additional savings because flight-deck crewmembers would be available to continue revenue operations without disruption.

On the other hand, flight-deck crewmembers would not be familiar with firefighting procedures in case of flight-deck fires or fires in other locations of the airplane for which their assistance may be required.

This alternative is rejected because safety requires that flight-deck personnel be proficient in extinguishing fires whether in the cockpit or other parts of the airplane.

Trade Impact Assessment

This proposal, if adopted, would have little or no impact on trade opportunities for U.S. firms doing business overseas or for foreign firms doing business in the United States. The proposal primarily affects Part 121 certificate holders and places the operating certificate holder as the party responsible for the provision of acceptable PBE.

Thus, both domestic and foreign manufacturers would not be affected by the proposals. Since most Part 121 operators compete domestically for passenger revenues with other U.S. operators, the proposal will not cause a competitive fare disadvantage for U.S. carriers.

Conclusion

Under the terms of the RFA, the FAA has reviewed these proposals to determine what impact they may have on small entities. The proposals included in this notice will have a significant economic impact on a substantial number of small entities. The FAA finds, however, that there are no alternatives to these proposals which would provide the traveling public with an equivalent level of safety against the hazards of in-fligth fires provided by the proposals contained in this notice.

These proposals, if adopted, are not likely to result in an annual effect on the economy of $100 million or more, or a major increase in costs for consumers; industry; or Federal, State, or local government agencies. Accordingly, it has been determined that these are not major proposals under Executive Order 12291. In addition, the proposals, if adopted, would have little or no impact on trade opportunities for U.S. firms doing business overseas or for foreign firms doing business in the United States.

Since the proposals concern a matter on which there is a substantial public interest, the FAA has determined that this action is significant under Department of Transportation Regulatory Policies and Procedures (44 FR 11034; February 26, 1979).

A draft regulatory evaluation of the proposals, including a Regulatory Flexibility determination and Trade Impact Assessment, has been placed in the regulatory docket. A copy may be obtained by contacting the person identified under the "FOR FURTHER INFORMATION CONTACT."

List of Subjects in 14 CFR Part 121

Aviation safety, Safety, Air carriers, Air transportation, Aircraft, Airplanes, Airworthiness directives and standards, Transportation, Common carriers.

The Proposed Rule

Accordingly, the Federal Aviation Administration proposes to amend Part 121 of the Federal Aviation Regulations (14 CFR Part 121) as follows:

PART 121—CERTIFICATION AND OPERATIONS: DOMESTIC, FLAG, AND SUPPLEMENTAL AIR CARRIERS AND COMMERCIAL OPERATORS OF LARGE AIRCRAFT

1. The authority citation for Part 121 is revised to read as follows:

Authority: Secs. 313(a), 314, 501, 601 through 610, and 1102 of the Federal Aviation Act of 1958, as amended (49 U.S.C. 1354(a), 1355, 1401, 1421 through 1430, and 1502); 49 U.S.C 106(g) (Revised, Pub. L. 97-449, January 12, 1983); 14 CFR 11.45.

2. By revising the title and text of § 121.337 to read as follows:

§ 121.337 Protective breathing equipment.

(a) The certificate holder shall furnish protective breathing equipment meeting the equipment, oxygen, and communication requirements contained in paragraph (b) of this section and the minimum performance standards of TSO-C99, Protective Breathing Equipment.

(b) *Pressurized cabin airplanes.* After (a date 1 year after the effective date of this proposed amendment), no person may operate a transport category airplane unless protective breathing equipment meeting the requirements of this section is provided as follows:

(1) *General.* The equipment must protect the flightcrew from the effects of smoke, carbon dioxide, or other harmful gases while on flight-deck duty and must protect crewmembers while combatting fires on board the aircraft from the effects of smoke, carbon dioxide, or other harmful gases.

(2) The equipment must include—

(i) Masks covering the eyes, nose, and mouth; or

(ii) Masks covering the nose and mouth plus accessory equipment to cover the eyes.

(3) That part of the equipment protecting the eyes must ensure that the wearer's vision is not impaired to the extent that crewmember duties cannot be accomplished and must allow corrective glasses to be worn.

(4) The equipment, while in use, must allow the flightcrew to use the radio equipment and to communicate with each other while at their assigned duty stations. The equipment must also allow crewmember interphone communications for each of two flight crewmember stations in the pilot compartment to at least one normal flight attendant station in each passenger compartment.

(5) Oxygen requirements are as follows:

(i) The equipment must supply protective oxygen to each crewmember for 15 minutes at a pressure altitude of 8,000 feet with a respiratory minute volume of 30 liters per minute BTPD (body temperature conditions, at ambient pressure, dry, 37 °C) (98.6 °F).

(ii) If a demand oxygen system is used, a supply of 300 liters of free oxygen at 70 °F (21 °C) and 760 mm Hg. pressure meets the requirements of paragraph (5)(i) of this section.

(iii) If a continuous flow protective breathing system is used (including a mask with a standard rebreather bag), a flow rate of 60 liters per minute at 8,000 feet (45 liters per minute at sea level) and a supply of 600 liters of free oxygen at 70 °F (21 °C) and 760 mm Hg. pressure meet the requirements of paragraph (5)(i) of this section.

(6) The oxygen equipment must also meet the requirements of paragraphs (b) and (c) of §25.1441 of this chapter.

(7) Protective breathing equipment with a fixed or portable oxygen supply meeting the requirements of this section must be conveniently located on the flight deck and be easily accessible for immediate use by each required flight crewmember at his/her assigned duty station.

(8) Protective breathing equipment with a portable oxygen supply meeting the requirements of this section must be easily accessible and conveniently located for immediately use by crewmembers, other than flight crewmembers, as follows:

(i) One for use in each Class A, B, and E cargo compartment (as definded in § 25.857 of this chapter) that is accessible to crewmembers in the compartment during flight;

(ii) One in each upper and lower lobe galley for each crewmember expected to be in these areas during any operation;

(iii) One on the flight deck; and

(iv) In the passenger compartment, one located within 3 feet of each hand fire extinguisher requried by § 121.309.

(c) *Nonpressurized cabin airplanes.* The requirements of paragraphs (a) and (b) of this section apply to nonpressurized cabin airplanes if the Administrator finds that it is possible to obtain a dangerous concentration of smoke or carbon dioxide or other harmful gases in the flight-deck area in

any attitude of flight that might occur when the airplane is flown in accordance with either normal or emergency procedures.

(d) *Nonpressurized cabin airplanes with a built-in carbon dioxide fire extinguisher system in a fuselage compartment.* Each certificate holder operating a nonpressurized cabin airplane that has a built-in carbon dioxide fire extinguisher system in a fuselage compartment shall provide protective breathing equipment meeting the requirements of paragraphs (a) and (b) of this section for the flight crewmembers except where—

(1) Not more than 5 pounds of carbon dioxide would be discharged into any compartment in accordance with established fire control procedures; or

(2) The carbon dioxide concentration at each flight crewmember station has been determined in accordance with § 25.1197 of this chapter and has been found to be less than 3 percent by volume (corrected to standard sea level conditions).

(e) *Euipment preflight.* (1) Each item of protective breathing equipment having either a fixed or portable oxygen supply must be checked and determined to be operating properly before each flight crewmember takes off in that aircraft for his/her first flight of the day. The protective breathing equipment must be checked by the flight crewmember who will use the equipment to ensure that the equipment is functioning, fits properly, and is connected to appropriate oxygen supply terminals and that the oxygen supply and pressure are adequate for its use.

(2) Each item of protective breathing equipment located at other than flight crewmember duty stations having a portable oxygen supply must be checked by the responsible crewmember and determined to be operating properly before he/she takes off in that aircraft for his/her first flight of the day. The PBE must be checked by the crewmember designated by the certificate holder in its operations manual to ensure that the equipment is properly stowed and serviceable and the oxygen supply is fully charged.

3. By amending § 121.417 by revising paragraph (c), by redesignating paragraph (d) as (e), and by adding paragraphs (d) and (f) to read as follows:

§ 121.417 Crewmember emergency training.

* * * * *

(c) Each crewmember must accomplish the following emergency training during the following training periods, using those items of installed emergency equipment for each type of aircraft in which he/she is to serve (Alternate recurrent training required by § 121.433(c) may be accomplished by approved pictorial presentation or demonstration):

(1) *One-time emergency drill requirements to be accomplished during initial training.* Each crewmember must perform—

(i) At least one approved firefighting drill using at least one type of installed hand fire extinguisher, appropriate for the type of fire to be fought, while using the type of installed protective breathing equipment required by § 121.337; and

(ii) An emergency evacuation drill, with each person egressing the aircraft or approved training device using at least one type of installed emergency evacuation slide. The crewmember may either observe the aircraft exits being opened in the emergency mode and the associated exit slide/raft pack being deployed and inflated, or perform the tasks resulting in the accomplishment of these actions.

(2) *Additional emergency drill requirements to be accomplished during initial training and once each 24 calendar months during recurrent training.* Each crewmember must—

(i) Perform the following emergency drills and operate the following equipment:

(A) Each type of emergency exit in the normal and emergency modes, including the actions and forces required in the deployment of the emergency evacuation slides;

(B) Each type of installed hand fire extinguisher;

(C) Each type of emergency oxygen system to include protective breathing equipment;

(D) Donning, use, and inflation of individual flotation means, if applicable; and

(E) Ditching, if applicable, including but not limited to, as appropriate:

(*1*) Cockpit preparation and procedures;

(*2*) Crew coordination;

(*3*) Passenger briefings and cabin preparation;

(*4*) Donning and inflation of life preservers;

(*5*) Use of life-lines; and

(*6*) Boarding of passengers and crew into a raft or a slide/raft pack.

(ii) Observe the following drills:

(A) Removal from the airplane (or training device) and inflation of each type of life raft, if applicable;

(B) Transfer of each type of slide/raft pack from one door to another;

(C) Deployment, inflation, and detachment from the airplane (or training device) of each type of slide/raft pack; and

(D) Emergency evacuation including the use of slide.

(d) After (1 year after the effective date) no crewmember may serve in operations under this part unless that crewmember has performed the firefighting drill prescribed by paragraph (c)(1)(i) of this section.

* * * * *

(f) For the purposes of this section, "perform" means accomplishing a prescribed emergency drill using established procedures which stress the skill of those persons involved in the drill and "observe" means to watch without participating actively in the drill.

Issued in Washington, DC, on October 2, 1985.

William T. Brennan,

Acting Director of Flight Standards.

[FR Doc. 85-24234 Filed 10-9-85; 8:45 am]

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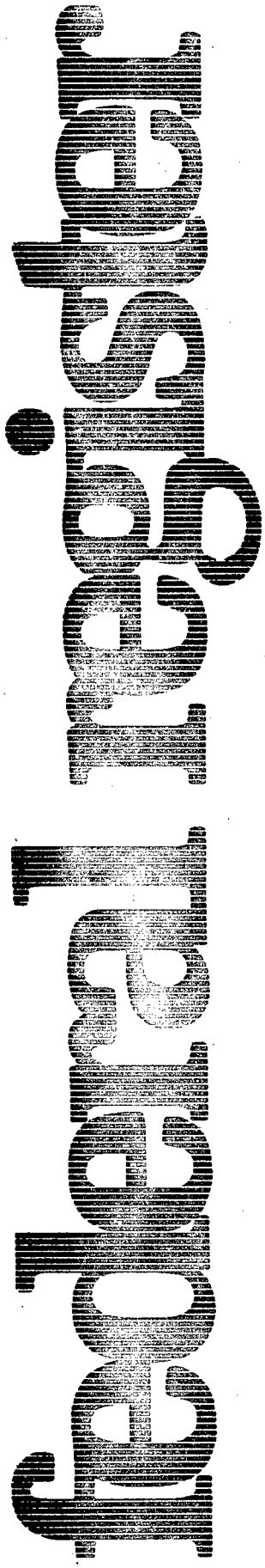

Thursday
January 9, 1986

Part III

Department of Transportation

Federal Aviation Administration

14 CFR Parts 11 and 121
Emergency Medical Equipment Requirement; Final Rule

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Parts 11 and 121

[Docket No. 21369; Amdts. No. 11-29 and 121-188]

Emergency Medical Equipment

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Final rule.

SUMMARY: This amendment requires certificate holders to carry in their aircraft medical kits containing equipment for use in the diagnosis and treatment of medical emergencies that might occur during flight time. The amendment further requires each certificate holder to report such medical emergencies annually for 2 years after implementation of the rule and to describe how the medical kit was used, by whom, and the outcome of the medical emergency. The intended effect of this amendment is to enhance the potential for diagnosis and initial treatment of medical emergencies during flight time.

EFFECTIVE DATE: August 1, 1986.

FOR FURTHER INFORMATION CONTACT: Andrew F. Horne, Biomedical and Behavioral Sciences Division, (AAM-510), Office of Aviation Medicine, telephone (202) 426-3433, Federal Aviation Administration, 800 Independence Avenue SW., Washington, DC 20591.

Lawrence Bedore, Project Development Branch, (AFS-240), Air Transportation Division, Office of Flight Standards, telephone (202) 426-8096, Federal Aviation Administration, 800 Independence Avenue SW., Washington, D.C. 20591.

SUPPLEMENTARY INFORMATION:

Background

Section 121.309 of the Federal Aviation Regulations (FAR) provides, in pertinent part, that no person may operate an airplane unless it is equipped with approved first-aid kits for treatment of injuries likely to occur in flight or in minor accidents. These kits must be one to four in number (depending on the number of aircraft passenger seats), be distributed as evenly as practicable throughout the aircraft, and be readily accessible to the crewmembers. Each first-aid kit includes such items as antiseptic swabs, ammonia inhalants, various bandages, tape, splints, scissors, and burn compound.

By letter and petition dated March 3, 1981, Sidney M. Wolfe, M.D., and Eve Bargmann, M.D. Public Citizen Health Research Group of the Aviation Consumer Action Project (ACAP), 2000 P Street, NW., Washington, DC 20036, petitioned to amend §§ 121.309(d) and 121.333(e)(3) of the Federal Aviation Regulations (FAR) to require the carriage of emergency medical equipment in commercial flights in addition to that carried in the first-aid kit. That petition was published verbatim in the **Federal Register** on August 20, 1981 (46 FR 42278). The FAA received comments from 370 interested persons on that petition for rulemaking.

Those commenters expressing support of the proposal urge that U.S. air carriers be required to have on board their aircraft emergency medical equipment and medication that would enable crewmembers and/or medically qualified passengers to respond to any in-flight medical emergency.

A number of physicians describe their involvement in in-flight medical emergencies. Those emergencies include such conditions as myocardial infraction, allergic reaction to food, acute asthma, epileptic seizures, and childbirth. Several commenters provided suggestions as to the specific types of emergency equipment and medication that should be carried.

Those commenters opposing the proposal express concern about the potential added cost to the traveler and the possible use of medical equipment and/or medication by unqualified individuals.

The majority of physicians who commented on the ACAP petition agree that the first-aid kits now required on aircraft by Part 121 of the FAR are inadequate for purposes of diagnosing and treating most in-flight medical emergencies. These physicians strongly recommend that diagnostic equipment be provided on all flights as well as equipment and medication that may be used for the treatment of medical emergencies that may be expected to occur. Many of these physicians indicate the need for "good samaritan" legislation to protect from liability those that use the medical equipment to treat in-flight medical emergencies. Whether or not such protection would be desirable, it would require legislation and is beyond the scope of FAA rulemaking authority.

On March 14, 1985, the FAA published Notice of Proposed Rulemaking (NPRM) No. 85-9, Emergency Medical Equipment, in the **Federal Register** (50 FR 10444). This NPRM proposed amendments to Part 121 of the FAR enhancing the potential for care of medical emergencies occurring during flight time, and an amendment to Part 11 of the FAR on reporting and recordkeeping requirements pursuant to the Paperwork Reduction Act. These proposed amendments include the requirements for the carriage of a medical kit on each passenger-carrying flight that would contain equipment and drugs to provide basic life support during medical emergencies that might occur during flight time, additional crewmember training consisting of familiarization with the medical kit, and annual reports of in-flight medical emergencies resulting in use of the kit for a period of 2 years after the effective date of the rule.

In making this proposal, the FAA recognized that unresolved issues remain regarding medical kits to be carried in operations conducted under Part 121 of the regulations. Public comment was specifically invited in the notice on such matters as who would be considered qualified to use the proposed kit, the user's licensing requirements, and whether or not the kits should be required on all flights or limited to flights of long duration where diversion to a ground facility is not possible.

Analysis of Comments

The FAA received approximately 140 public comments in response to NPRM No. 85-9, Emergency Medical Equipment. It is noteworthy that the public response to the NPRM includes comments from several medical associations, air carrier associations, labor organizations, and air carrier certificate holders, as well as interested individuals and providers of equipment and consultant services. This is in contrast to the public response to the publication of the petition in 1981 when the comments were largely from individuals. Since that time, bills have been introduced in both the United States Senate and House of Representatives to require the carriage of medical equipment in commercial aircraft.

Of 46 individual physicians commenting on the NPRM, 44 support expanded medical kits. Some, however, believe that the proposed kit is too sophisticated and that some of the drugs should be deleted because of the potential for misuse. Some believe that the requirement should be limited to only certain air carriers conducting long over-water flights, and that responses to the reporting requirement should be used to determine the future need for medical kits on air carriers. Others recommend additional equipment and drugs ranging from bandages to cardiac monitor/defibrillators, and that a physician should be required on every

transoceanic flight. Some physicians believe that "good samaritan" protection from liability is necessary to ensure that physicians will voluntarily provide assistance in the event of a medical emergency.

Only two physician commenters are opposed to the proposed requirement for the carriage of medical kits on air carriers. One, while opposed to the kit, voices strong support for required reporting of all in-flight medical emergencies and believes that the data acquired would provide a basis for the development of "intelligent regulations." This physician also believes that the presence of the proposed medical equipment on board would result in a tendency "to try to make do with the available equipment," thereby delaying any decision for immediate landing. He states that such a delay may result in risk to the ill person greater than the benefit of the available medical equipment. Another physician states that a stethoscope and a blood pressure recording cuff might be provided, but opposes more equipment and drugs because of the likelihood of misuse.

Seven registered nurses commented on the NPRM. Of the five in favor of expanded medical kits, some are concerned about misuse of the equipment and drugs, and one believes that "good samaritan" protection from liability is necessary. Two believe that a registered nurse should be included in the cabin crew complement on every flight. Two registered nurses oppose the NPRM. Both are concerned that the possible misuse of the equipment may be more detrimental to the patient than the alternative of first-aid procedures and immediate diversion to a ground facility. One of the commenters said that, "No one can predict when a medical emergency will arise. Being in your own home, a car, a bus, a train, the supermarket, etc., does not carry a guarantee that emergency help will be available. Having drugs and equipment available will not guarantee reversal of a crisis situation either. Improper use of these items might prove more disastrous. No commercial airline should have to assume this responsibility."

There were numerous comments from non-medical individuals favoring medical kits being required on air carrier aircraft. Very few of these commenters, however, address such issues as who should be authorized to use the kits. Many comments are anecdotal in nature, relating the commenters' experiences or those of friends involved in medical emergencies which occurred in flight.

Seven non-medical individuals are opposed to the proposal. One questioned his personal physician regarding the NPRM. His physician was reportedly concerned with the proposed drugs and stated that they should be used only by a physician trained in their usage and that not all physicians would be qualified to use those drugs. He further stated that some of the drugs should be used only with sophisticated monitoring equipment which would not be available. One opposing commenter, a flight attendant, states that because of the low frequency of in-flight medical emergencies, the cost-benefit ratio and the possibility of misuse of the equipment, the requirement for medical kits is not warranted. Other non-medical individuals opposing the NPRM express concern about misuse of the kit and the possibility of those using the kit not being qualified. One believes that the risks of misdiagnosis and misapplied drugs far outweigh the small potential benefit of saving a life by use of that kit.

Nine providers of medical equipment and consultant services are in favor of expanded medical kits on air carrier aircrafts, as is the National Transportation Safety Board.

Four air carrier labor organizations responded to the NPRM. The Air Line Pilots Association (ALPA) favors the proposals, but indicates concern for issues not addressed. The expressed issue of most concern is that of liability for kit use and the need for "good samaritan" legislation to protect crewmembers and physicians who might provide in-flight medical assistance. The Airline Operations Control Society opposes the proposal for several reasons. They believe the surgical instruments could be used to hold a person hostage during a hijacking, the presence of the proposed drugs would result in security problems, and there would be a potential for misuse of the kit by an improperly trained person. This organization also believes that if the medical kits are to be required, "good samaritan" legislation is necessary to protect crewmembers as well as users of the kit. Two flight attendant unions favor the NPRM and also recommend an "expanded first-aid kit" for use by flight attendants. One of the flight attendant groups provides information on the carriage of medical equipment by certain European airlines, indicating that a physician's kit (similar to the medical kit proposed in NPRM 85-9) is "mandatory for flights in which an airport cannot be reached in 90 minutes," and that the first-aid kit (similar to those now required on United States air carrier aircraft) "is mandatory on every flight when an airport cannot be reached in 60 minutes."

Eight small air carriers operating under Part 121 of the Federal Aviation Regulations oppose the NPRM, most stating that their flights are short and that the probability of an individual qualified to use the kit being on board is not as high as it is among the large air carriers using larger aircraft and making longer flights. They raise issues including liability for us of the kit, security of the equipment and drugs, and training requirements for crewmembers. Several note that it would be necessary for an air carrier to employ a physician to procure the drugs and they are concerned with licensing requirements when the drugs must be replenished in another state.

Three air carrier associations responded with comments opposing the NPRM. The Air Transport Association (ATA), representing the major scheduled air carriers in the United States, questions the justification for the requirement for carriage of the medical equipment and drugs on air carrier aircraft. The ATA cites the American Medical Association (AMA) Commission on Emergency Medical Service's independent study to evaluate the problem of in-flight medical emergencies on commercial airlines. This study suggests that the frequency of life-threatening medical emergencies on commercial flights is not high. The study concludes that the first-aid kits currently carried are satisfactory. The ATA also raises such issues as liability for use of the medical equipment, security of the drugs, syringes and needles in the kit, who is qualified to use the kit, the U.S. Drug Enforcement Administration (DEA) regulatory requirements concerning controlled substances, and the concern that air carrier procurement of drugs will require employment of appropriately licensed physicians. The ATA further discusses the potential for misuse of the kit and the possibility that hesitation in diversion of a flight because of the presence of a kit could prove detrimental to the patient. ATA states that "proper consideration of this rule must await the results and analysis of the proposed 2-year reporting requirement to determine the need for carriage of medical kits."

Also commenting are the Regional Airline Association (RAA) and the National Air Carrier Association, Inc. (NACA). The RAA, representing approximately 100 "short haul" regional and commuter air carriers, objects to the requirement that their members operating under Part 121 carry the

proposed medical kit on their aircraft. These aircraft normally seat 31 to 50 passengers with 1 flight attendant crewmember and are never more than 30 minutes from an airport where professional and competent medical assistance can be obtained. The RAA further states that they are unaware of any in-flight medical emergencies in commuter/regional operations that would have benefitted from the proposed medical kit. Both the RAA and NACA raise the same issues of liability, security, potential for misuse, accountability for controlled substances, and need for a physician in order to procure the proposed drugs in the kit.

Seven associations representing physicians and two associations representing nurses responded to the NPRM with comments varying from full support to total opposition. Their responses also contain constructive criticism concerning the proposed contents of the kit.

The AMA cites the 1981 study by its Commission On Emergency Medical Services on in-flight medical emergencies aboard commercial air carriers, noted previously. The AMA also discusses its other activities in this area, including: its encouragement of physicians to carry medical kits when they travel that contain instruments and drugs with which they are familiar; AMA publications on the contraindications to air travel for persons suffering from certain illnesses and conditions; and, AMA support for federal legislation providing "good samaritan" immunity to physicians and other qualified individuals offering emergency medical assistance on board aircraft. The AMA comment includes opposition to the requirement for a medical kit containing surgical equipment and drugs because of its belief that the potential for misuse outweighs any benefit that might be gained through the availability of such equipment. The AMA supports expansion of the current kit to include stethoscope, sphygmomanometer, airways, splints, tongue blades, and flashlight.

The American College of Emergency Physicians does not support the NPRM as proposed. They believe that there are inadequate data and experience to support the list of medical equipment and drugs proposed either from a medical or cost-benefit perspective. They further state that these data are needed to ensure that an enhanced emergency medical kit best meets the needs of the flying public. They recommend that the FAA devise and implement a data collection system which generates detailed information concerning in-flight medical emergencies so that better decisions can be made about the contents of the emergency medical kit.

The Civil Aviation Medical Association (CAMA) opposes the requirement for medical kits on domestic flights and questions the need for such kits on transoceanic flights. CAMA expresses concern about the potential for misuse of the kit and raises issues including liability and the identification of qualified users of the kit. CAMA further states that most critical medical emergencies can be managed well with relatively simple cardiopulmonary resuscitation.

Four other physicians associations generally favor the proposal, two of which mention the importance of "good samaritan" protection from liability if the kit is to be used effectively. These associations are the American Academy of Family Physicians, the American College of Chest Surgeons, the American Society of Anesthesiologists, and the American Osteopathic Association.

The Emergency Nurses Associations (ENA) supports the general concept of expansion of the medical kit but does not believe controlled substances and most cardiac drugs should be included. The ENA recommends that nitroglycerin, epinephrine, and Benadryl (diphenhydramine) be included. The ENA also supports "good samaritan" protection from liability.

The American Association of Critical-Care Nurses (AACN) also support the general intent of the NPRM but expresses concern about the possibility of misuse of the medical equipment and/or drugs proposed. The AACN makes recommendations concerning recordkeeping and raises the question of how crewmembers will identify a qualified user of the kit. The AACN states that the proposed injectable cardiac drugs should not be included in the kit unless a cardiac monitor is available, and that qualification to use the kit should include special training in emergency care.

Discussion

After careful review and analysis of comments on the publication of both the ACAP petition and NPRM No. 85-9, several unresolved issues remain. Many commenters believe that "good samaritan" protection from liability is necessary for effective use of the proposed medical kit. Such protection would immunize any personnel who utilized the kit in the diagnosis and treatment of medical emergencies that might occur during flight time from the consequences of their own negligence. Many states have "good samaritan" laws in effect but there exists no provision in current Federal law affording such protection. It is not clear whether the Federal government should provide this protection, or it is properly a matter for state law. The applicability of state laws to personnel utilizing medical kits in an aircraft during flight time is also unclear.

Some commenters believe that the proposed requirement for the carriage of medical equipment should only apply to flights of long duration (such as transoceanic) where immediate diversion to a ground facility is not possible. Others believe that the equipment should be required on all flights.

In addition, all the drugs proposed in the NPRM require procurement by a licensed physician. Controlled substances present a special problem because of state and federal inventory and accountability requirements and the potential for misuse and pilferage.

With regard to these issues, the FAA has considered other significant information pertaining to the proposed requirement for the carriage of emergency medical equipment on air carrier aircraft. Of special note are concerns expressed by the Senate Commission on Commerce, Science and Transportation. In Senate Report 99-93 dated June 27, 1985, on the In-flight Medical Emergencies Act, the committee said:

> Although the Committee supports carriage of an enhanced medical kit aboard commercial aircraft, it is clear that these kits should not contain dangerous surgical instruments, such as scalpels or other incisive devices, or controlled substance, as defined in the Comprehensive Drug Abuse Prevention and Control Act of 1970 (21 U.S.C. 801 et seq.). These items, even in the most sophisticated of hospital emergency facilities, must be handled with extreme caution and only in conjunction with the elaborate diagnostic equipment and expertise available at such facilities. They are not suitable for carriage in an onboard medical kit.

In consideration of all the views expressed, the FAA has determined that the carriage of an expanded medical kit on passenger-carrying operations conducted under Part 121 of the regulations is appropriate. As noted above, it has been suggested that such kits need not be required on flights of short duration or those that seat a limited number of passengers. The FAA concludes, however, that the presence of kits on such flights is essential to ensure that appropriate medical equipment and medication are available for immediate use in the event of a medical emergency

involving any air carrier traveler. In so doing, it is recognized that the likelihood for use of the kit on such flights will be less than on flights which have a large number of passengers, are of longer duration, or where the flight cannot be readily diverted to a ground facility. Nevertheless, medical emergencies may occur on these flights and qualified medical personnel may be present to provide assistance. In addition, although ground facilities may be close by, some medical emergencies may result in loss of life, distraction of crewmembers; and disruption of flight routine, unless treatment is provided immediately.

While may commenters expressed the belief that "good samaritan" legislation is necessary to protect from liability those persons who use the kit, existing state "good samaritan" laws may apply in certain circumstances and, in any event, the FAA believes that the absence of such legislation does not justify a withdrawal of the proposal. In this respect, the FAA believes that, in the event of an emergency, qualified medical personnel will voluntarily come forward, just as they do now, to provide assistance and, when indicated, use the medical equipment and medication made available. We note that Congress is considering legislation regarding good samaritan laws.

The required contents of the medical kit are modified by the elimination of all surgical instruments and controlled drugs. This resolves or reduces many of the concerns regarding security, the potential for liability for use of the kit, the burden of required DEA recordkeeping and accountability, congressional concerns, and the objections of numerous commenters, as discussed previously. The surgical instruments eliminated consist of the hemostats, scalpel, surgical scissors, and the tracheal airway set. The controlled substances deleted consist of the morphine sulfate injection, amobarbital injection and diaszepam injection. Several prescription drugs that require monitoring equipment or which have a significant potential for misuse are also deleted. These consist of lidocaine HC1 injection, atropine sulfate injection, sodium bicarbonate injection, prochlorperazine injection, and aminophylline injection. Because of the retention of certain prescription drugs in the kit that are adequate for the short-term treatment of acute allergic reactions and bronchospasm, the FAA believes upon re-evaluation that the adrenocortical steroid injection is unnecessary and, therefore, this item is deleted. Because of the elimination of the parenteral cardiac drugs, the intravenous set and 5% dextrose injection, used for their administration, are not necessary. The prescription drugs retained in the kit consist of nitroglycerin tablets, epinephrine injection, diphenhydramine injection, and 50% dextrose injection. These drugs do not have the same potential for misuse or require monitoring equipment as do those drugs deleted. It is recognized that certificate holders will require the assistance of licensed physicians in obtaining these drugs. No flashlight is included in the kit since regulations currently require the carriage of operable flashlights as emergency equipment.

While modification of the contents of the proposed medical kit somewhat reduces its potential for use in providing basic life support during medical emergencies, the equipment and drugs retained still enhance the diagnostic and treatment capability of users of the kit. At the same time, the modification eliminates equipment and drugs which, if misused, could compromise the health of the passengers and the safety and security of the flight. The training requirement for crewmember familiarization with the emergency medical kit remains as proposed.

As recommended by numerous commenters, the rule requires the maintenance of records and the reporting of medical emergencies as proposed. An analysis of the results at the termination of the reporting requirement in 2 years will provide the FAA with information on medical emergencies occurring in flight so that any necessary changes can be made to the medical kits, training of personnel, or related matters.

The regulations do not specify who should be permitted to use the kit. The FAA has determined that resolution of this question must be left to each air carrier since it depends, to some extent, upon the nature of and circumstances surrounding each medical emergency.

The effective date of this rule has been established as the first day of the seventh month after publication in the **Federal Register.** Thus, 6 months is provided for each Part 121 air carrier to acquire appropriate medical kits, install the kits on each airplane, and develop procedures for the use, control, maintenance, recordkeeping, and reporting requirements associated with the kits.

Regulatory Evaluation

The total costs of implementing the amendment to require emergency medical kits include the cost of equipping existing passenger aircraft which will become subject to the rule, the installation of emergency medical kits in new aircraft manufactured during the 10-year period covered by this evaluation, physicians' services related to procuring the contents of the kits, the fuel penalty resulting from the added weight of the emergency medical kits, and the maintenance costs.

Certain costs of the rule are different than those of the NPRM. Since some contents of the proposed kit have been deleted in the rule, the cost for purchase and maintenance of the kit is lower than that stated in the NPRM. Also, the lighter weight of the kit reduced the fuel weight penalty. However, the cost for physicians' services related to procuring the contents of the kits is an additional cost which was not stated in the NPRM.

Each aircraft will be equipped with one emergency medical kit regardless of the number of individual first-aid kits on the aircraft. The FAA has estimated that such emergency medical kits can be purchased and installed for approximately $100 per unit. The cost of equipping existing passenger aircraft with emergency medical kits has been estimated to be approximately $233,000 (2,333 aircraft x $100).

Indications are that approximately 140 newly manufactured aircraft will be delivered annually for Part 121 passenger operations during the 10-year period following implementation of the rule. The total discounted present value is approximately $90,000 for equipping newly manufactured aircraft with emergency medical kits.

To determine the fuel costs for the additional weight of the emergency medical kits, the FAA estimates that during each year of the 10-year period following implementation of the proposal, an average of 3,103 emergency medical kits will be aboard passenger aircraft operated under Part 121. Each emergency medical kit weighs approximately 7 pounds, and each additional pound of weight will result in an estimated average fuel consumption of 15 gallons per year per aircraft. Based on a fuel price of 89.4 cents per gallon, each emergency medical kit will result in an average additional fuel cost of slightly more than $94 per year. The present value cost of the additional fuel consumption during the 10-year period is estimated to be $1,880,000.

Maintenance costs for the emergency medical kits are based on an average requirement of 2 person-hours in labor annually, assuming that the average wage rate (including benefits) will be $35 per hour and that 10 percent of the emergency medical kits will require replacement at a unit cost of $100. The present value of maintenance costs is

estimated to be approximately $1,600,000.

Modification of the requirements for instruction in the handling of emergency situations under § 121.417(b)(3)(iv), to include familiarization with the emergency medical kit, results in a negligible increment of training time. Therefore, no additional cost is ascribed to this modification.

Purchasing certain contents of the kits, including prescription drugs, makes necessary an additional cost for the periodic services of physicians. This cost is based on one physician's consultation per month at $250 per consultation to provide for a bulk purchase for prescription contents for the kits of a carrier operating under FAR Part 121. Currently, there are 80 carriers actually operating under Part 121, although more than 100 are certificated to do so at a particular time. The total discounted present value of consulting services 1 day per month at $250 per day for 80 carriers during the 10-year period is estimated to be $1,547,000. We note that many airlines currently employ, or contract with, physicians for medical services.

The costs for creating and maintaining records on how the required emergency medical kit was used, by whom, and the outcomes of medical emergencies are based on an expected average requirement of 1 person-hour in labor per medical emergency. The costs for submitting these records or a summary to the FAA is a negligible amount of time and expense for postage and handling of the reports. Although the amended § 121.715 requires record maintenance for 2 years, FAA anticipates that after 2 years these records will continue to be created and maintained voluntarily for other reasons, including standard policies and procedures relating to liability insurance and handling of prescription drugs. Assuming that the average wage rate (including benefits) will be $35 per hour, and that an average of 2,500 medical emergencies would occur in flight per year, the present value of in-flight medical emergency costs for creating and maintaining records is estimated to be approximately $564,000.

The present value of all estimated costs resulting from the emergency medical kit amendment during the 10-year period following implementation is $5,914,000.

The FAA cannot estimate easily the prospective number of lives that may be saved or the reduction of in-flight morbidity by providing additional equipment and medications, but some insight into the potential benefits can be gained from a major air carrier's experiences with in-flight deaths and in-flight medical emergencies. A major commercial air carrier under Part 121 has tracked in-flight deaths for approximately 4 decades.

The FAA has estimated the number of in-fligth deaths occurring annually for all carriers by calculating the proportion of the annual number of deaths in flight to the annual number of passengers carried by the major carriers. Then, the same proportion of annual "estimated in-flight deaths" is applied to the total annual number of passengers carried by all Part 121 carriers. Using this method of analysis, the FAA estimates that over a period of 4 decades, approximately 840 in-flight deaths occurred on all carriers. Moreover, the number of deaths in flight, as a proportion of passengers carried, has grown progressively smaller in successive years as the number of annual enplanements has increased at a rapid rate. The annual in-flight deaths vary in number within a small range, and the FAA further estimates that approximately 21 deaths currently occur in flight annually. These estimates are based upon historical information provided to the FAA by an air carrier. Public estimates of in-flight deaths range to 100 annually.

From historical information, the FAA estimates that a great majority of the in-flight passenger deaths are elderly people suffering from terminal illnesses such as cancer and heart disease. Many of these in-flight deaths occur quietly and without others being aware of the onset of the medical emergency. However, some in-flight deaths can be prevented with the new rules. The number who might be saved is uncertain, but based on fragmentary information obtained from airline data, the estimate is about 10 percent of in-flight deaths. Thus, according to FAA estimates (21) and public estimates (100), about 10 percent of the annual in-flight deaths, or 2 to 10 persons, might have been helped annually by an emergency medical kit.

For purposes of economic studies, the FAA values a life at $650,000 in 1983 dollars. The expected number of lives that could be saved over the 10-year period is 21 to 100. The expected present discounted value of the lives that could be saved over the 10-year period ranges from $8.4 million to $41.9 million. This is derived by discounting the value of life at a 10 percent rate.

Based on these estimates, the benefit/cost ratio ranges from a low value of 1.42 ($8.4 million÷$5.9 million) to a high of 6.76 ($41.9 million÷$5.9 million). The FAA's preliminary judgment is that the lower ratio will prevail. Clearly, information gained in the course of implementing the amendment will help in refining estimates about future costs and benefits.

Trade Impact

The amendment will have little or no impact on trade for both U.S. firms doing business in foreign countries and foreign firms doing business in the United States. The amendments will affect only U.S. air carriers because foreign air carriers are not subject to Part 121. Foreign air carriers are prohibited from operating between points within the United States; therefore, they will not gain any competitive advantage over the domestic operations of U.S. carriers. In international operations, foreign air carriers would realize some minor cost advantages over U.S. air carriers if the foreign countries do not require similar emergency medical equipment. However, these costs are negligible in comparison to the overall costs of providing international passenger services; therefore, the rule change will essentially have no trade impact.

Regulatory Flexibility Determination

The small entities affected by the amendment are the small air carriers which are regulated under Part 121. The FAA has published a size threshold of nine or fewer operating aircraft as a standard for small air carriers. According to FAA data for the period ended April 1983, 45 passenger air carriers which were subject to Part 121 operated nine or fewer aircraft.

The impact on small entities will be in direct proportion to the number of aircraft they will be required to equip with the emergency medical kit. The average annualized net compliance cost for a small carrier to meet the emergency medical kit requirements is estimated to be approximately $217 per aircraft. The FAA has adopted threshold values that define small entities and significant economic impact, and these values are stated in FAA Order 2100.14. The threshold values for economic impact are adjusted for inflation and are expressed here in 1983 dollars. The threshold value for small entity carriers is a maximum number of nine aircraft owned or operated. The threshold values for significant economic impact are an annualized cost of $47,506 for scheduled carriers and $3,314 for unscheduled carriers.

Since the annualized cost per aircraft is $217 per year, a small entity carrier with the maximum number of aircraft, nine, would not meet the cost impact criteria for either scheduled or unscheduled air carriers (9 x $217 is less

than $3,314). Therefore, this amendment is not expected to have a significant economic impact on a substantial number of small entities, and a regulatory flexibility analysis is not required.

Conclusion

Since the amendment contained in this document would enhance the potential for diagnosis and initial treatment of in-flight medical emergencies, and the amendment could possibly save two lives per year, the estimated benefits exceed the estimated costs of implementing this amendment. For the reasons discussed above, I certify that under the criteria of the Regulatory Flexibility Act, these amendments do not have a significant economic impact on a substantial number of small entities, and a regulatory flexibility analysis is not required. In addition, for the same reasons, the amendment does not involve a major rule under Executive Order 12291. Because it involves important DOT policy, the amendment is considered significant under DOT Regulatory Policies and Procedures (44 FR 11034; February 26, 1979). A copy of the regulatory evaluation for this regulatory action is contained in the regulatory docket. A copy of it may be obtained by contacting the person identified under the caption **"FOR FURTHER INFORMATION CONTACT."**

Paperwork Reduction Act

Information collection requirements in this regulation (§ 121.715) have been approved by the Office of Management and Budget under the provisions of the Paperwork Reduction Act of 1980 (Pub. L. 96–511) and have been assigned OMB Control Number 2120–0523.

List of Subjects

14 CFR Part 11

Reporting and recordkeeping requirements, Air carriers, Air transportation.

14 CFR Part 121

Aviation safety, Safety, Air carriers, Air transportation, Aircraft, Drugs, Common carriers, Medical kits.

Adoption of the Amendment

In consideration of the foregoing, Parts 11 and 121 of the Federal Aviation Regulations (14 CFR Parts 11 and 121) are amended, as follows:

PART 11—GENERAL RULEMAKING PROCEDURES

1. The authority citation for Part 11 is revised to read as follows:

Authority: 49 U.S.C. 1341(a), 1343(d), 1348, 1354(a), 1401 through 1405, 1421 through 1431, 1481, 1502, 49 U.S.C. 106(g) (Revised Pub. L. 97–449, January 12, 1983).

2. By amending § 11.101 by adding a new OMB Control Number to the table in paragraph (b), as follows:

§ 11.101 OMB control numbers assigned pursuant to the Paperwork Reduction Act.

* * * * *

(b) * * *

121.715	2120–0523

PART 121—CERTIFICATION AND OPERATIONS: DOMESTIC, FLAG, AND SUPPLEMENTAL AIR CARRIERS AND COMMERCIAL OPERATORS OF LARGE AIRCRAFT

3. The authority citation for Part 121 is revised to read as follows:

Authority. 49 U.S.C. 1354 (a), 1355, 1356, 1357, 1401, 1421 through 1430, 1472, 1485, and 1502; 49 U.S.C. 106(g) (Revised, Pub. L. 97–449, January 12, 1983).

4. By amending § 121.309 by revising paragraph (d) to read as follows:

§ 121.309 Emergency equipment.

* * * * *

(d) *First-aid and emergency medical equipment.* Approved first-aid kits and, on passenger flights, an emergency medical kit for treatment of injuries or medical emergencies that might occur during flight time or in minor accidents must be provided and must meet the specifications and requirements of Appendix A.

* * * * *

5. By amending § 121.417 by revising paragraph (b)(3)(iv) as follows:

§ 121.417 Crewmember emergency training.

* * * * *

(b) * * *

(3) * * *

(iv) Illness, injury, or other abnormal situations involving passengers or crewmembers to include familiarization with the emergency medical kit; and

* * * * *

6. By adding a new § 121.715 as follows:

§ 121.715 In-flight medical emergency reports.

(a) For a period of 24 months commencing with the effective date of this rule, each certificate holder shall maintain records on each medical emergency occurring during flight time resulting in use of the emergency medical kit required under Appendix A, diversion of the aircraft, or death of a passenger or crewmember. These records shall include a description of how the medical kit was used, by whom, and the outcome of the medical emergency.

(b) The certificate holder shall submit these records, or a summary thereof, to its assigned FAA Principal Operations Inspector within 30 days after the end of each 12-month period during the 24 months specified in paragraph (a).

7. By amending Appendix A to Part 121 by revising the title, by adding a subheading before the current text, and by adding a new subheading and text, as follows:

Appendix A—First-Aid Kits and Emergency Medical Kits

First-Aid Kits

* * * * *

Emergency Medical Kits

The approved emergency medical kit required by § 121.309 for passenger flights must meet the following specifications and requirements:

(1) Approved emergency medical equipment shall be stored securely so as to keep it free from dust, moisture, and damaging temperatures.

(2) One approved emergency medical kit shall be provided for each aircraft during each passenger flight and shall be located so as to be readily accessible to crewmembers.

(3) The approved emergency medical kit must contain, as a minimum, the following appropriately maintained contents in the specified quantities:

Contents	Quantity
Sphygmomanometer	1
Stethoscope	1
Airways, oropharyngeal (3 sizes)	3
Syringes (sizes necessary to administer required drugs)	4
Needles (sizes necessary to administer required drugs)	6
50% Dextrose injection, 50cc	1
Epinephrine 1:1000, single dose ampule or equivalent	2
Diphenhydramine HCl injection, single dose ampule or equivalent	2
Nitroglycerin tablets	10
Basic Instructions for use of the drugs in the kit	1

Issued in Washington, D.C. on December 31, 1985.

Donald D. Engen,

Administrator.

[FR Doc. 86–414 Filed 1–8–86; 8:45 am]

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